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Public safety training and education in the context of fourth industrial revolution: Dimensions of global knowledge enterprise

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ABSTRACT

In the landscape of the Fourth Industrial Revolution (4IR), the integration of its transformative elements into educational frameworks has become crucial, and the National Police College stands at the forefront of this endeavor. This study centers on public safety training and education within the context of the global knowledge enterprise. With a commitment to advancing human capital and leadership in the face of a VUCA world, the college has strategically incorporated 4IR principles across its curriculum, faculty, pedagogy, learning outcomes, and instructional delivery. Employing a quantitative research design, this study engages in the systematic collection and generalization of numerical data to elucidate the nuances of this phenomenon. Through rigorous analysis utilizing Exploratory Factor Analysis, the extracted factors yield significant insights. The exceptional Kaiser-Meyer-Olkin (KMO) test result of 0.921 and the Bartlett's test result of .000 (< 0.05) validate the robustness of the dataset. The application of Principal Component Analysis for extraction and Varimax with Kaiser Normalization for rotation reveals three distinct dimensions or factors—strategic management, inclusive curriculum design, and collaborative learning environment—that underpin the college's effective public safety training and education. As the institution aligns its strategies with the ever-evolving demands of the 4IR, this research offers a comprehensive understanding of how to equip public safety officers with the skills and knowledge needed to navigate the challenges of a VUCA world while embracing the opportunities of the global knowledge enterprise.

I. Introduction

In the present age, the global community stands on the cusp of significant changes that are reshaping the ways in which people engage, innovate, manufacture, and exercise judgment. These elements are fundamentally revolutionizing human connections within societies, among different geographical areas, and with the environment at large (Artuso & Guijt, 2020).

The push for economic expansion has presented humanity and the entire Earth system with enormous issues and challenges. While it provided incremental benefits for many, it may have worsened the risk and vulnerability for others. Indeed, it has decreased but not totally eliminated the causes of hunger and malnutrition, resulting in large disparities between what people require to keep healthy and what present food systems generate (Woodhill et al., 2020). It is wreaking havoc on the ecosystem and driving climate change, with resource depletion jeopardizing the Earth system on which everyone depends.

The associated uncertainties and tensions are connected to political division and public discontent, with the consequences being exacerbated for those who are victims of structural injustices, particularly gender-based inequities of various types. These are the global megatrends that bring out transformational global forces and determine the future by inducing impacts to business, economies, industries, society, and individuals (E.Y., 2015).

A pertinent case in point challenging the national safety and security is the ongoing global health crisis which exemplifies how a widespread disease may jeopardize not just humanity's physical well-being but also the whole socioeconomic framework (Garnier et al., 2020). The penetrating disease brought on by the fear of pandemic damaged and immobilized the social structure and dynamics by creating frightening and terrible death tolls and wreaking economic havoc. According to reports, several enterprises in the country have seen huge revenue losses and layoffs, putting many countries on the verge of recession and resulting in volatile stock market activity (Chenli et al., 2021). While the Philippine government does everything it can to protect its citizens from illnesses and viral dangers through vaccinations and other health measures, the virus mutates and genetically duplicates itself to a new strain, this time more contagious and lethal.

The beginning of the twenty-first century triggered massive alterations in all sectors, and it is the rising technology that architected such upheaval. Perhaps the most evident indicator of change is technology (Ball, 2012). In the realm of public safety, technology brings innovative means to respond to crime, and public safety personnel today have an array of high-tech systems and tools meant to enhance it. This transformational police push factor pushes change, sparks new ideas, and adapts to changing context and application, enabling interventions and partnerships that keep society safe.

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The Internet of Things (IoT) and smart sensors, for example, supply raw data with precise analytics to improve the efficiency of police investigations. The data they create may be used to track locations, check databases, stream video, and begin virtual patrolling, allowing public safety officials to become more socially conscious. There are also technological advancements like as 5G connection, electronic miniaturization, and augmented reality to assist them view relevant information and take extra care to protect themselves and better serve the public. Small autonomous drones, on the other hand, may be programmed to accompany public safety officials throughout any operation, explore the area, and offer enough data to cover traces of evidence (Masoud et al., 2019; UNCTAD, 2021).

Interestingly, the use of robots equipped with Artificial Intelligence (AI) can augment the public safety sector to perform far-fetched police activities and operations that can imperil their lives. This includes detonation of bombs or entering foreign and unknown territories. The promising Artificial Intelligence (AI) and machine learning can also act as investigators that will sift through the data and find the most likely leads to identify any suspect of crime. This can be done through pattern analysis, sensor feeds, and databases of records. More so, AI possibly helps law enforcement determine many critical places, locate key linkages between and among suspects, and search other acumens concealed in a sea of data (Alzou'bi et al., 2014; Joh, 2018).

Ultimately, the direction of public safety enforcement is shifting to artificial intelligence, which is expected to improve organizational efficiency throughout the Fourth Industrial Revolution (Melrose, 2018). Global developments such as the Industry 4.0 and the CoViD-19 crisis render the country's landscape into a more volatile, uncertain, complex, and ambiguous (VUCA) world. Indeed, these tendencies have significantly aided in the restructuring of the higher education sphere.

The National Police College (NPC) Davao, a frontier constitutive unit of the Philippine Public Safety College (PPSC), is mandated to provide continuing education and career training needs for the officers of the uniformed services of the PNP, the BFP and the BJMP through the mandatory Officers Training Courses it offers. The implementation of the training programs such as the Master in Public Safety Administration (MPSA), Public Safety Officers Senior Executive Course (PSOSEC), Public Safety Officers Advance Course (PSOAC), Public Safety Officers Basic Course (PSOBC), and Public Safety Officers Basic Course (PSOBC) Lateral is designed to develop quality and excellence in management and leadership of public safety officers for the overall enhancement of public safety. It is through this program that the commitment to adhere to the PPSC's institutional philosophy of developing a professionalized corps of public safety personnel all towards the realization of the PPSC's Legacy Plan 2020–2030 ACCELERATE: Surge towards a Sustainable Future is realized.

As a strategy to cope with the global trends, the institution has modified and upgraded its Program of Instruction almost rebooting its educational model to stay attuned with the Fourth Industrial Revolution or Industry 4.0 that is gearing towards Digital Education. It reckoned that this contemporary time is an era of virtual learning for the commons, hence, at the very heart of PPSC's instructional delivery is the development of Information and Communication Technology (ICT) infrastructure and the integration of Flexible Learning Management Systems (FLMS) as a modality for teaching and learning which incorporates the use of various courseware such as self-learning modules and the use of broadcasting media paving the way towards digital fluency and intellectual legitimacy among the public safety student-officers and the subject-matter experts.

Through technology utilization, the public safety officers take advantage of diving into an array of Massive Open Online Courses with the latest global expertise, trends, and technology in learning that help them to acquire global skills and attributes to become highly competent public safety officers. The interactive digital participation, publicly-shared curriculum, and open-ended outcomes create a potent space for digital global diplomacy through shared ideas and experiences from other countries. With the maximization on the role of technology in this new normal, the College can bring limitless opportunities to grow and see the world through a wider lens of the future of education.

The World Economic Forum stated in 2016 that technological advancements in Industry 4.0 are expected to change production, consumption, and employment, and that all sectors of society (private and public sectors, including individuals) will need to be proactive in their involvement or collaboration, as well as adapt to this rapid and technological change (WEF, 2016b). The efficiency of the main stakeholders' adaptation is dependent on the timeliness of their preparation, implementation, and common methods, particularly of the National Police College Davao.

The challenge for higher education, particularly for the Philippine Public Safety College and National Police College, is to reinvent a robust and anti-fragile academic paradigm. The National Police College strives to successfully integrate the elements of 4th industrial revolution into its curriculum, faculty, pedagogy, learning outcome, and instructional delivery among others to advance the human capital and leadership of the public safety officers in dealing with the VUCA world. It is therefore imperative for the National Police College to explore the dimensions of public safety training and education that is anchored on the global knowledge enterprise, hence, the conduct of this study.

II. Review of Related Literature and Studies

Public Safety and Security in the 4th Industrial Revolution

The evolution of public order and security systems surely reflects the evolution of the economic and social connections. Technology is frequently developed first in military and security groups, and afterwards it appears as civilian items. Crime is targeted at unlawfully gaining things by both organized and disorganized criminals. With the

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expansion of industry, money – capital, moveable and immovable property, storage in banks – all of this is of interest and desire to the criminal world for illicit acquisition. It is subject to development and the utilization of the benefits of technological growth since it is dissolved in the normal environment (Attali, 2011; Burrows, 2014).

According to Radulov (2019), criminals are growing more inventive, educated, clever, and ruthless. Criminals who are well-educated and well-equipped devise increasingly inventive methods of illicit gain. As a result of citizenship and taxation, ordinary people deserve proper protection from the government. The majority of the crimes are directed at large sums of money. This aligns the interests of the affluent and poor in seeking greater security. As a result, resources are set aside, professionals are educated, and research and development are underway to combat crime and, of course, espionage. Without resource-intensive development, there can be no creative industrial development.

Clearly, no technological breakthrough is irrelevant in light of the need for security – rail transport, in addition to its economic importance, allows for easy transport of people over long distances, whether military formations, criminals, or police forces; aviation, and photography, in addition to their exceptional iconic significance, have a great value since their emergence for intelligence, counterintelligence, military, and special operations. Cybercrime, cyber-intelligence, and cyber-security are interrelated industrial and social phenomena that show the possibilities of modern crimes as well as the development of modern goods for civil and national security (Radulov, 2019).

Each step of industrial growth correlates to a level of security system development. As a result, when we consider security in the context of Industry 4.0 ideas, we are discussing revolutionary paradigms, technologies, and security technologies that match the high technology that we may group under the umbrella term Public Safety and Security 4.0.

Skills and Competencies in the 4th Industrial Revolution

As cited by Deckha (2020), six foundational literacies were identified by the World Economic Forum 2016: literacy, numeracy, scientific literacy, financial literacy, cultural and civic literacy, and literacy in information and communication technology; four competencies such as collaboration, creativity, communication, and critical thinking/problem solving; and six character traits or aptitudes such as curiosity, initiative, perseverance, adaptability, leadership, and social and cultural awareness. Furthermore, the World Economic Forum lists complex problem solving, critical thinking, and creativity as the top three skills for 2020 in its Future of Jobs Report. Managing people, coordinating with others, emotional intelligence, judgment and decision making, service orientation, negotiation, and cognitive flexibility follow in the list (Soffel, 2016).

In discussing highly human jobs, Samson (2013) argued that in the face of automation and artificial intelligence, humans should focus more on developing our "highly human" skills. These skills can be described as those that are too unorthodox, unforeseen, affective, or intuitive to program or automate. Clear example of such are perceptiveness, awareness, responsibility, and caring," as well as creativity and subjective judgment and decision-making.

Surprisingly, these human qualities are non-cognitive abilities that are more rewarded, especially when combined with specific technical abilities. Grundke et al., (2018) investigated how cognitive and non-cognitive talents are rewarded in technologically demanding businesses by deconstructing an Organization for Economic Cooperation and Development (OECD) Survey of Adult Skills. These sectors encompass finance and insurance, legal and accounting, scientific research, public administration, along with computer and electronic equipment, machinery, and others. Non-cognitive abilities assessed were learning preparedness, problem solving skills, management, communication, and self-organization. According to Grundke et al., (2018), bundles of skills are especially essential for employees in digital industries since workers bestowed with a high level of mathematical skills receive an extra pay differential when they also demonstrate high degree of self-organization or managing and communication skills. Additionally, while computers replace humans in everyday activities, they supplement workers in more sophisticated, situational tasks involving problem-solving or communication.

This demonstrates the possibility for people to work alongside machines and robots rather than being replaced by them provided they possess highly human qualities such as problem solving and communication, as suggested by Samson (2013) and the World Economic Forum (WEF, 2016a). Furthermore, Waldrop (2013) as cited by Penprase (2018) investigated the Fourth Industrial Revolution's influence on higher education, noting that the Third Industrial Revolution's mass computerization resulted in online and remote education learning, as well as massive online open courses (MOOCs).

When non-cognitive, highly human skills (such as creativity, problem solving, and communication) are combined with desirable cognitive skills (such as numeracy skills exemplified by mathematics, science, and engineering), they show where comparative educational and employment advantages may exist for future adult learners and workers (Deckha, 2020).

Higher Education in the Context of Industry 4.0

Fahim et al., (2021) cited that according to the research, higher education is one of the most important drivers of development, wealth, and competitiveness in national and global economies. Higher education may expand skills in the knowledge-based economy of Industry 4.0 through university-industry links, the formation of a quality workforce, the stimulation of innovation, the upskilling of current workforces, and an increase in employability. Because education is expected to adjust to economic and political trends rather than oppose them and stand for something different, the link between education and society is frequently considered one-way. As a result, educational approaches must be improved to cover the latest changes brought about by Industry 4.0 demands (Chan, 2016; Diwan, 2017; Xing & Marwala, 2017).

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Enhanced technologies and innovations are critical criteria for an improved curriculum to eliminate educational hurdles. Managers, engineers, technicians, and employees with abilities and capabilities in the essential core technologies are needed for Industry 4.0: big data, cloud computing, IoT, 3D printing, augmented reality, simulations, and so on (Achelia et al., 2018). However, according to Dumitrescu et al., (2019), the existing academic curriculum of higher education degrees do not meet the current requirement of Industry 4.0.

The higher education system must equip graduates with the skills and competences needed for employment in a period when many things are networked and mechanized. For example, one of the primary goals of higher education is to assure the quality of learning through teaching. The purpose is to empower students and human capital in general to upgrade and modify their knowledge via research and development, as well as to sustain societal betterment through service and engagement (Gleason, 2018). It is therefore integral for higher education to supply organizations with analytically adept and intellectual workers who are adaptable, imaginative, and creative. As a result, there is an urgent need to redesign higher education curriculum in order to generate students with greater technological skills and competences that are compatible with the working environment of Industry 4.0.

In the case of the National Police College, there is a dire need to properly incorporate the facets of the fourth industrial revolution into its curriculum, faculty, pedagogy, learning outcomes, and instructional delivery, among other things, in order to advance public safety officers' human capital and leadership in dealing with the rapidly changing public safety and security trends.

III. Methods

The study utilized a quantitative research design concerned with collecting numerical data and generalizing it across groups of individuals to explain a specific phenomenon. The generated dimensions were pilot tested and were treated through Principal Component Analysis using Exploratory Factor Analysis. The study's respondents were the student-officers and the staff of the National Police College. The population was determined through stratified sampling technique whereby the researcher divides a population into homogeneous subpopulations called strata based on specific characteristics like gender, campus, and rank among others. Each stratum was then sampled using another probability sampling method –simple random sampling to estimate statistical measures for each sub-population.

The dimensions were analyzed using exploratory factor analysis (EFA). This statistical tool was used to identify and extract the dimensions of global knowledge enterprise of fourth industrial revolution. The method of extraction of the underlying structure is Principal Component Analysis (PCA).

IV. Results and Discussion

Sampling Adequacy and Test of Sphericity

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity are preliminary tools to determine the data appropriateness taking into account the sample size adequacy for factor analysis. It means that the factorability of variables is dependent on the sampling adequacy (Hair et al., 2010; Pallant, 2007; Tabachnick & Fidell, 2007).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.921
Bartlett's Test of Sphericity	Approx. Chi-Square	6085.832
	df	741
	Sig.	.000

Table 1. KMO and Bartlett's Test

Table 1 showed the KMO test result of 0.921 and the Bartlett's test result of .000 which is less than 0.05 ($\alpha < .05$). According to Hair et al., (2010), a KMO result equal or greater than 6, and a Bartlett's Test of Sphericity that is significant at $\alpha < .05$ are recommendable. The result falls under the meritorious (≥0.80) classification and is significant at the said threshold level, therefore, the samples are adequate enough to be treated for factor analysis.

Eigenvalues and Scree Test

In determining the number of factors that need to be extracted among the variables, eigenvalues are important measure that indicate the extent of variance attributed by each factor. Through a scree test, eigenvalues are placed and plotted for all factors. The criterion in determining the total number of factors extracted is based on the rule of thumb of Kaiser (1960) which suggests that all factors that are above the eigenvalue of 1 are meaningful (Yong & Pearce, 2013).

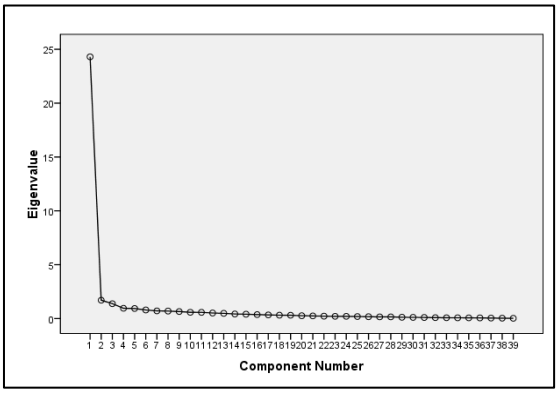

Figure 1. The Scree Plot Diagram

It can be gleaned from the figure above that there are three (3) factors which fall above the eigenvalue of 1. From the point where it dropped off sharply, all other factors are considered "non-meaningful" (Tabachnick, & Fidell, 2007).

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Rotated Component Analysis

Table 2 below shows the extraction method carried out through Principal Component Analysis and the rotation method using Varimax with Kaiser Normalization.

Variables	Component		
	1	2	3
Prepares student-officers for lifelong learning, i.e. making sure the training competencies develop the ability and readiness of student-officers to engage in continuous learning throughout their professional lives as public safety stewards		.743	
Offers 'big picture education', keeping in mind the bigger picture of how the course/program fits into the overall learning trajectory and labor market"		.670	
Considers not only professional development, but also societal needs (sustainability, ethics) and student-officers' needs/individual characteristics (i.e. respecting diversity of student-officers' contexts and capacities) development and implementation "		.714	
Shifts from knowledge towards competencies that student-officers should acquire for their personal development and professional development and inclusion in a knowledge society; adding a dimension of Mindsets, e.g. Growth, Innovation, Ethics and Safety"		.694	
Ensures freedom of curriculum goals and learning outcomes from conventional qualification frameworks to offer relevant personalized/personal learning"		.589	
Viewing student-officers as change agents and actively engaging them in curriculum development and implementation"		.628	
Upgrades the technical side of the curriculum to accommodate the learning of next generation robotics, additive manufacturing, smart materials, Artificial Intelligence and machine learning, Internet of Things, predictive analytics, augmented and virtual reality technologies etc."		.412	
Incorporates non-technical disciplines into the curriculum (e.g. communication, project management, arts, marketing etc.), in order to develop cross-cutting competencies and a mindset beyond technical expertise"		.507	
Pays special attention to the questions of ethics, social inclusion, diversity and sustainability (e.g. incorporating the Sustainable Development Goals (SDGs) into the curricula) "		.702	
Offers a holistic view of a product and system life cycles, in which student-officers learn to alternate between the abstract and the precisely detailed, to deconstruct big problems and accept failure and model real-life situations by simplifying assumptions"		.651	
Teaches student-officers how to acquire knowledge from the ever increasing 'ocean' of data, and how to find out what to make of it when it has been found"		.594	
Teaches student-officers to be mindful of their safety and ergonomics at work, and specifically about the necessity of maintaining good physical and mental health, and the possible consequences of risk exposure (including what can be done about it)"		.623	
Integrates Futures Thinking in the context of public safety into or across the curricula"		.680	
Further increases stakeholder-industry collaboration in terms of both volume and diversity of collaboration forms (e.g. internships, mentoring, project banks, think tank competitions, etc.)"			.664
Acknowledges the role of industry partners as educational, research and employment partners, and ensuring their engagement in the full learning experience, including strategy development"			.536
Creates more opportunities for exchanging experiences with other educational institutions (e.g. via joint platforms, thematic networks etc.)"			.613
Facilitates peer-to-peer learning, to enable student-officers to learn with and from each other as fellow student-officers"			.314
Creates effective learning ecosystems that engage all key stakeholder groups, including education & training providers, industry, policy makers, supporting structures and broader community"			.374
Encourages human-machine interaction (use of technology) and human-machine collaboration (e.g. autobots) as an evolving collaboration form"			.786
Encourages research topics and agenda aligned with technology and industry 4.0. "			.532
Involves in publication of researches (international/national) vis-à-vis technology and industry 4.0."			.497
Applies problem-based learning, i.e. stimulating student-officers to work on challenging real-life problems for which there are no established answers; "	.781		
Encourages student-officers to contextualize their theoretical learning in relation to how it would be useful in the world around them"	.684		
Instead of focusing on standardized thinking, corrects answers and objectivity of judgment and creates a learning environment that would stimulate creativity, forming of own opinion and divergent interpretations"	.608		
Creates learning environments that can offer experiences relevant to real-world working conditions (i.e. in a physical and/or virtual form, maximally resembling a factory setting, featuring modern and state-of-the-art equipment)"			.748
Encourages collaborative learning by offering suitable physical spaces and virtual platforms for diverse forms of collaboration, including collaboration with peers, industrial partners, community etc."	.744		
Stimulates technology-enabled learning by encouraging the use of technology and software applications for learning, including Massive Open Online Courses (MOOCs), mLearning, gamification, Augmented and Virtual Reality, Artificial Intelligence etc.;"		.	.789
Uses of digital technologies in educational setting as the core qualification of Education 4.0"			.612

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Integrates digital technologies with education as one of the main prerequisites of innovation-based education"			.570
Instructors give constant guidance and mentoring maintaining mentor-teacher figure instead of the classical authoritarian teacher figure in any platforms (physical or online)."	.613		
Invites/accredits digitally competent instructors to achieve Education 4.0."	.670		
Instructors integrate technological pedagogies in the teaching-learning process. "	.620		
The management possess learning skills such as creative thinking, problem solving, critical thinking, sensitive communication, collaboration skills, and catching up technological developments."	.451		
The management is responsible for the transfer and efficient use of computers and related technologies in the teaching-learning process."	.338		
Instructors and managers give guidance and mentorship to develop student-officers' skills in using new technologies."	.528		
Management places learning culture at the campus by directing some stakeholders on technology and motivating stakeholders to offer technical capability building for staff, instructors, and clienteles."	.653		
Managers have skills such as organizing, coordinating, empowering staff, and adopting a participatory decision-making mechanism in the context of technical skills."	.766		
Managers develop among themselves human skills and decentralized decisions such as making informed decisions and solving urgent problems in a short time."	.597		
The management invests in technology, give importance to improving the technological skills of the human resources, and support innovative ideas."	.624		

Table 2. Rotated Component Matrix

By critically examining the factor loadings to determine the strength of the relationships between the variables and the factors, the highest factor loadings were generally retained. Those are the factors that fall at .30 or higher. With the presence of split loading, a phenomenon where a variable fits under two or more factors, the variables were placed under the factors for which they have the highest factor loading values (Costello & Osborne, 2005; Tabachnick & Fidell, 2007).

In summary, there are fourteen (14) items under Factor 1, thirteen (13) under Factor 2, and twelve (12) under Factor 3. Each factor is named based on the codes that best represent the variables within the factors (Yong & Pearce, 2013).

For Factor 1 (*Strategic Management*), the codes affirm the processes and strategies that can be employed by the management in implementing and executing the standards and operations. According to Sammut-Bonnici (2015), strategic management is a process designed to maintain or even improve the processes to make the organization more competitive. The first factor is then named "strategic management" evoking the planning, implementation, and evaluation as strategies of the National Police College in conducting its curriculum in the context of Industry 4.0.

Factor 2 leans towards *Inclusive Curriculum Design*. Competencies, knowledge acquisition, curriculum goals, and learning outcomes are some of the codes that depict curriculum design. Curriculum design covers the goals, learning outcomes, objectives, syllabus, teaching strategies and methods, and assessment ensuring accessibility and inclusivity among the learners (Thanavathi, 2019).

Collaborative Learning Environment is the theme for Factor 3. It entails the collaboration of learners, partner institutions, stakeholders, and other concerned partners in designing a learning environment that is digitally-oriented and technologically-ready (Schuster et al., 2016).

V. Conclusion

This research underscores three pivotal factors in shaping the global knowledge enterprise of the National Police College within the realm of Industry 4.0. The first factor, "strategic management," elucidates the institution's adeptness in incorporating meticulous planning, effective execution, and rigorous evaluation strategies into its curriculum development process. The second factor emphasizes "inclusive curriculum design," highlighting the integration of competencies, knowledge acquisition, curriculum goals, and learning outcomes to cater to diverse learner needs. The third factor, "collaborative learning environment," accentuates the significance of fostering partnerships among learners, partner institutions, stakeholders, and other concerned parties to craft a digitally-immersed and technologically-prepared educational milieu. Collectively, these findings illuminate the college's forward-looking approach in aligning its curriculum with the demands of Industry 4.0 while promoting adaptability, inclusivity, and collaborative engagement.

VI. Recommendations

In light of these findings, it is recommended that the National Police College consider implementing a cohesive curriculum strategy that synergizes the identified factors. This could involve developing a framework that integrates strategic planning with inclusive design principles, while actively promoting collaborative interactions among students, partners, and stakeholders. Furthermore, the college should explore the incorporation of innovative digital tools and technologies to enhance the learning environment and align with the digitally-driven landscape of Industry 4.0. By adopting an integrated approach informed by these findings, the college can better equip its learners with the requisite skills and knowledge to thrive in an ever-evolving technological landscape.

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