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A survey on Students' Academic Performance in Smart Campuses

Ezugwu* Assumpta, Nweke Onyinye, Aneke Stephen
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Abstract: *The concept and issue of a smart campus have received broad discussions and are now open knowledge. It typically comprises a network of people, devices (mobile and non-mobile), and 'things' (with connecting abilities) which are powered by the Internet of Things (IoT). A smart campus was designed to enhance education through the utilization of modern state-of-the-art machines that employ the use of recent technologies to bring about effective learning and management of the educational sector. This work aimed at surveying existing works to determine students' academic performances in a smart campus. A survey was carried out on publications on smart campus from 2000 to 2021, then on academic performance. It was discovered that infrastructure and resource management attracted more publications while governance attracted the least. It was equally discovered that most academic performance predictions centred on cumulative grade point(average) (CGP(A)) as the parametric determinant.*

Keywords : *Smart campus, performance, predict*

Assumpta Obianuju Ezugwu
Department of Computer Science, University of Nigeria, Nsukka, Enugu State, Nigeria
Email: assumpta.ezugwu@unn.edu.ng
Orcid id: 0000-0002-9761-1785

Onyinye Nweke
Department of Computer Science, University of Nigeria, Nsukka, Enugu State, Nigeria
Email: onyinye.nweke@unn.edu.ng

Stephen Okechukwu Aneke
Department of Computer Science, University of Nigeria, Nsukka, Enugu State, Nigeria
Email: stephen.aneke@unn.edu.ng

1.0 Introduction

The concept and issue of smartness in cities, buildings, devices, and most things have received broad discussions and are now open knowledge (Coccoli *et al*., 2014). . It has also received wider acceptance which has enabled its application in most communities including the universities. Consideration of a smart campus suggests that it is comprised of a network of people, devices (mobile and non-mobile), and 'things' (with connecting abilities) that are powered by the Internet of Things (IoT) (Coccoli *et al*., 2014; Majdi, 2021)., A smart campus will help in the enhancement of education by enabling the use of modern technologies to attract effective learning and management of the educational sector. Benefits that come as a result of a smart campus include (Majdi, 2021) smart and personalized learning, easy assessment of students' performances, effective classroom and library management, automated identification of people on campus, and smart and secure attendance management.

Higher institutions can take advantage of smart campus designs to improve the activities and output of the various departments concerned, this includes partial or total automation of facilities management, administration, student, and staff activities. A smart campus includes a collection of applications, platforms, infrastructures, and other related things. In addition, it makes use of a strategic framework that promotes a connected ecosystem and eventually creates a new and exciting experience for users. Emerging technologies are needed to implement the next-generation campus, which consists of technologies that are woven into the fabrics and processes of an institution to create smart communities for students and citizens (Deloitte, 2019).

Another facet of the smart technology on campus is in the area of the academic

performance of the students that have been integrated into the smart life on campus. The emphasis on the implementation of smart campuses is not just for a show of affluence or that the technology exists but for the easy and smooth running of activities on campus (Cocco *et al*., 2014). According to Liu *et al*. (2009), the technologies employed in the smart campus are intelligent enough to handle campus activities without so many human interventions. Liu *et al*. (2009) also remarked that being intelligent portrays a will that reveals the overall application of the vanguard technology and the description of the existed style mode of the new society and environment in a typical smart campus. According to Shahzadi *et al*. (2011), since in a smart campus, every activity is intelligently monitored and carried out, the academic lives of students are included because the academic performance of students through the grades or CGPA (Cumulative Grade Point Average) they graduate with remains the area of interest and emphasis as far as higher institutions of education are concerned. Kasarnig *et* al. (2018) remarked that this interest is largely so because the academic life in any university guides in making policies that concern admission and prevention of student dropouts is an integral part of the institution upon which the quality rating of an institution can be done.

Trying to come up with a unified definition of academic performance will be a herculean task because the understanding of academic performance means several things to several persons. Several researchers have given several definitions including Kassarnig *et al*. (2018), Alyahyan and Düştegö (2020), among others. Therefore, it is complex when factors such as *individual character, traits, social life, and educational history* greatly influence one's academic success or performance.

1.1 Smart campus

1.1.1 General ideology

The introduction of the Internet of Things (IoT) and its integration with cloud computing gave rise to the era of SMART technology (Nie, 2013). Although the smart technology is still at its infant stage of development, therefore (Muhamad *et al.*, 2017) explain why there is no common conical definition of a smart campus, every researcher then defines it from personal understanding. Given this, three (3) approaches have been recommended to form the base for defining a smart campus (Muhamad *et al*., 2017). They include the definition from the *technological* point of view, the *concept of a smart city*, and *organizational development.* Another notion of a smart campus suggests an environment that is ideal for learning, where everything happens exactly the way it should without so many human interventions. This is a sequel to the ideal characteristics as outlined in (Chuling *et al.,* 2009) that should constitute a smart campus because the students ought to be taught, managed, and served intelligently such that the absence of human involvement will not be felt. Again, the smart campus has to ensure proper management of learning resources such that these resources are provided on-demand and or shareable ones are adequately shared among users thereby eliminating the issue of monopoly and non-availability of resources.

1.1.2 Background Technologies

i. **Internet** – The influence of the Internet has gone beyond just the use of the computer as a technical communications device, now it is (Leiner *et al.*, 2017) the utilization of online tools to solve human needs which has extended it to other sectors such as commerce, information acquisition, security, and the community services. One of the main reasons the Internet could facilitate smart campuses is because (Leiner *et al.,* 2017) it runs an open-architecture network where every network can be designed and developed uniquely to address directly the needs of its users. In this case, one can say that the Internet has a nature that could accommodate and integrate heterogeneous networks to function together to achieve one common goal. The actual requirements for the design of the Internet are contained in (Tronco, 2010) which are as follows – (1) *data have to be transmitted through leased*

lines to take care of interruptions in phone lines. (2) *Any information that should be transmitted has to be split into segments of fixed length called packets* and (3) *the network (Internet) must be decentralized*, no single node should control the network because reliability and robustness are key in its functionality

ii. **Cloud computing** – this is a scenario that was used to actualize the paradigm shift from the use of desktop computers and the corporate server machines as the computing device in the world of computers. The core of this development is to concentrate computation power and storage capacity so that these resources can be effectively utilized, controlled and managed (Hayes. 2008; Ranger, 2018). The reason behind this is that high-performance machines are being linked together through high bandwidth connections for end-users to use on-demand. If individuals should continue to own these resources, there will be periods when they will be idling away while some others may need machines with high computation powers at those idle times. Again, considering the high cost of maintaining these resources (software or hardware), (Ranger, 2018) a user might not have the economic power to bear its maintenance since as the software improves, there should always be a corresponding hardware improvement as a follow-up. This now ensures that cloud computing (Hayes, 2008) becomes more comfortable because users' mobility wouldn't be a problem in terms of accessibility to pieces of information. The availability of information for everything, software for everything, and storage for everything has been made possible because of cloud computing.

iii. **IoT** – The Internet of Things was made possible because of the successes recorded on the Internet and cloud computing. At the level of cloud computing, resource usage, management, and control (Hayes, 2008) shifted away from the domain of the end-users to a third party that has the sole right to centrally manage these things according to the demands of the end-users. The IoT's basic idea (Atzori *et al.*, 2010) is the recognition of the presence of various things or objects around us which includes but is not restricted to Radiofrequency Identification (RFID) Tags, Sensors, Actuators, and Mobile phones. These objects are made to communicate and cooperate with each other to achieve a common goal. Remarkably, the IoT plays an effective role in every area of human endeavours (Atzori *et al.*, 2010; Mahmoud *et al*, 2018) such as healthcare, entertainment, automobile, education, industry, sports, and social life. It has been noted by (Mahmond *et al.*. 2018; Subbaroa *et al*., 2019) that the current shape of *the Internet of Things* is a result of the noticed rapid growth found in the inter-connected devices. These devices range from simple ones like the sensors to complex ones like the cloud servers (Subbarao *et al*., 2019).

Cooccoli *et al*. (2014) developed a framework that enables campus planners in Africa to effectively plan for a smart campus, using the University of Johannesburg in South Africa as a case study. In their investigation, they explored a different perspective of the smart campus including intelligent buildings, smart grids, and the learning environment. They also identified challenges such as unavailability of required technology, funding, and political effects that prevent the speedy implementation of smart campuses.

In analyzing the problems of traditional evaluation methods for teaching performance, Xu *et al*. (2018) proposed a new technique of combining modern technology with the evaluation of teaching performance. In their study, the Principle Component Algorithm was used to determine six principal components (network learning resource supply, student questionnaire, course welcome, interaction, and effective use duration, and the network teaching platform usage rate) while AHP (Analytic Hierarchy Process), a decision-making model was used to determine the weights of each of the indicator set's layers. Their research

reveals that a combination of the three algorithms can successfully evaluate a teacher's performance with the goal of having a theoretical basis for making judgments. They created a framework model for collecting data and storing it, focusing on the study topic of teacher performance evaluation in smart campuses in an educational environment. This can also be applicable in a smart campus environment while considering students' academic performances.

Q *et al.* (2018) have also designed a framework for the prediction of students' achievement. Their work covers the aspects of data processing that involve data extraction and cleaning with feature extraction. They also proposed a layer supervised MLP (Multi-Layer Perceptron) based method for predicting student achievement (academic performance). They enhance the performance of the prediction of student performance by feeding each hiding layer of the MLP with supervision.

In the provision of a comprehensive view of general types of smart campus applications, Abuarqoub *et al.* (2017) investigated how to leverage the Internet of Things to build a smart campus. Their paper identifies key benefits and motivations for building IoT-enabled smart campuses.

Sari *et al.* (2017) used IoT for smart campus implementation and concentrated on the areas of smart parking, smart education, and smart rooms. The research method applied by their investigation includes observation

and study of existing literature to design a smart campus. The Universitas PGR Yogyakarta was used as a case study in their work. Yang *et al.* (2018), analysed and determined a design for a smart campus service discovery algorithm and data fusion algorithm based on the situational awareness system framework of a smart campus based on the current research status of smart campus and the challenges in integrating various kinds of service data in the smart campus. They also considered the security of different layers of the smart campus including the network layer, application layer, and perception layer.

Through a systematic literature review comprising a review of 29 articles, Wardani *et al.* (2017) were able to illustrate the existing conditions of smart campus development in terms of the features supported by the technologies used for the implementation, and the applications. Their findings presented the use of contactless technologies which enables easy data collection instead of manually keying in data through a keyboard. Their research shows that IoT makes the reporting of real-time environmental status much simpler.

Based on the Wardani *et al.* (2017), Table 1 is presented to show some of the typical applications and implementations within a smart campus and their corresponding domain which has been classified into ilearning, iManagement, iSocial, iGovernance, iGreen, and iHealth,

2.0 Methodology

We grouped the various applications of smart campus into six (6) domains of iLearning, iManagement, iSocial, iGovernance, iGreen, and iHealth. Each of these domains has a specific need it addresses in a smart campus. The grouping has been provided in Table 1.

Table 1: Smart campus domains and applications

S/N	DOMAIN	APPLICATION
1	iLearning	Smart classrooms, smart learning management systems, assessment, library management system
2	iManagement	Smart attendance, people identification, smart parking, safe learning environment, campus geographic information system
3	iSocial	News management system, market management system
4	iGovernance	Financial Management system, office system, teaching management system
5	iGreen	Smart building, waste and water management system

6	iHealth	Patient and health Monitoring system

2.1 Search for smart campus publications

We searched for any publication on smart campus ranging from the year 2000 to the year 2021 to discover what several researchers have done in this field. A couple of search questions were formulated to enable us to have access to the publications and the search engine used was google. Some databases such as IEEE Xplore, Google Scholar, Science Direct, ResearchGate, and Academia.edu were searched and some search questions included smart campus, smart campus publications for the smart campus, publications on smart campus, smart campus concepts publications, and ideal smart campus.

2.2 Publication selection

During the search for the publications, we did not base our search on methodology, technique, or technology, rather we considered the *year of publication*. Because of this, we did not need to get everything and start the manual selection. Every publication that falls outside the range of the period was discarded immediately. The range of time was grouped into 3 which were 2000 – 2005, 2006 – 2013, and 2014 – 2021, the reason for this was to avoid duplications in our selection and we were able to select a total of 18 publications. Table 2 below shows a list of the selected publications of works that were carried out on the smart campus.

Table 2: A summary of work that has been carried out in the area of smart campus.

S/N	Year of publication	Authors	Title	Methodology	Purpose	Location
1	2003	Michael Rohs and Jürgen Bohn	Entry Points into a Smart Campus Environment – Overview of the ETHOC System	A software was developed which links the virtual campus to the existing physical campus	The ETHOC system concentrates on the aspect of linking virtual and real materials in such a setting, allowing users to attach virtual equivalents to printed material. Alternatively, in addition to the physical campus, a virtual campus might be created.	Switzerland
2	2001	Parviz Doula	SMART AND FLEXIBLE CAMPUS:	On Internet-connected PCs, interactive	To provide a system that includes an	University of Wollongong

			TECHNOLOGY-ENABLED UNIVERSITY EDUCATION	multimedia modules containing images, audio, and video files were used to accurately imitate a real classroom environment.	integrated set of educational tools that enable student communication and cooperation, as well as a variety of study help and class management features.	, Wollongong , Australia
3	2004	OK, S. I., & KIM, Y. S.	Smart Campus Design	The authors used a literature review to suggest how to design a smart campus	The paper suggested smart technology application to university campus design	Seoul Korea
4	2007	**Toni Anwar1; Wendy Goh Pek Mui2**	DESIGN AND IMPLEMENTATION OF A WIRELESS NETWORK SYSTEM IN A SMART CAMPUS	The authors designed and implemented a wireless network	The goals of this research were in designing a network that could bring mobility to all network users on this campus	Bangkok, Thailand
5	2009	McCord, M. R., Mishalani, R. G., & Goel, P.	Research and Education from a Smart Campus Transit Laboratory	Develop hardware, software, communications protocols, and institutional structures that allow data collected from the Smart Bus system to be processed and used regularly for research, education, and outreach purposes, among other things.	The goal of this project is to help the Ohio State University Campus Transit Lab (CTL) become a distinctive, well-known, and beneficial infrastructure for research, education, and outreach, both on campus and in conjunction with other universities.	The Ohio State University US

6	2007	Khan, M. T., & Zia, K.	Future Context-aware Pervasive Learning Environment: Smart Campus	A pervasive learning environment was designed and implemented	This proposed a novel design of an interactive pervasive learning environment.	Pakistan
7	2007	Raad, M. W., & Arabia, D. S	KFUPM Smart Campus and the Role of RFID in Academia	The researchers created contactless smart cards that use radio frequency identification (RFID) technology to identify persons and conduct financial transactions	The article provides an overview of RFID technology as well as information about the KFUPM smart campus.	Dhahran-Saudi Arabia
8	2010	S.!Masso ud!Amin	Smart!Grid:!T oward! stronger,! smarter,!and!m ore!secure!ene rgy! infrastructure	Create a smart self-healing grid system by combining microgrids, diversified generation, and storage resources.	Adapt the network to become a smart grid. Create a more extensive transmission system. Massive Electricity Storage Systems should be developed.	University of Minnesota
9	2000	Kaneko, A., Sugino, N., Suzuki, T., & Ishijima, S.	A Step Towards the Smart Campus: A Venture Project Based on Distance Learning by a Hybrid Video Conferencing System	The genuine Videoconferencing and Internet capabilities are combined in this system to help potential entrepreneurs network[sl[71] . Users can perform Independent research on-	The first step is to identify a group from the society and colleges, the best counselors and partners for would-be entrepreneurs , industry, and to provide them with a web-based environment	Tokyo Metropolitan Institute of Technology

				demand, as well as participate in live online conferences and discussions	where university-industry They may be able to launch new firms with the support of collaboration. The next phase collects, creates, and expands the human capital required, organizes the data obtained throughout this treatment.	
10	2003	Halawani, T., & Mohandes, M.	SMART CARD for SMART CAMPUS KFUPM Case Study	The author uses a literature review to illustrate the history and types of smart cards, as well as the key features of the KFUPM smart card system.	The smart card program's objective is to give users safe, fast, friendly, easy-to-use, flexible, personal services that are accessible from any location at any time.	Saudi Arabia
11.	2021	Bart Valks et. al.	Towards a smart campus: supporting campus decisions with the Internet of Things applications	Case study	The authors examine the decision-making processes of smart campuses through four case studies and highlight the process-level needs for making strategic decisions in campus management. They also	TU Delft, Netherlands

					demonstrate how the Internet of Things can be linked to these operations.	
12.	2021	Musa M, Ismail MN, Fudzee MF	Smart Campus Implementation in Universiti Tun Hussein Onn Malaysia: Towards a Conceptual Framework	Conceptual framework and survey	The researchers designed a conceptual framework for the Implementation of smart campus technology at Universiti Tun Hussein Onn Malaysia (UTHM) They followed it up with a pilot test to verify the effectiveness of the framework concerning the expected standards.	Malaysia
13	2019	Thanchanok Sutjaritthaam, Hassan Habibi Gharakheili, Salil S. Kanhere, Vijay Sivaraman	Experiences with IoT and AI in a Smart Campus for Optimizing Classroom Usage	Instrumenting classrooms using Internet of Things (IoT) sensors to track real-time usage, predicting attendance with AI, and allocating rooms to courses optimally to reduce space waste	Campus Resources optimization	**DOI:** 10.1109/JIOT.2019.2902410
14	2017	Manu Jain, N	Building Automation	Experiment	Presentation of automation	

		Kaushik, Mrs. Kayalvizhi Jayavel	And Energy Control Using IoT – Smart Campus		techniques and a module that works for room automation and ease of access to appliances with digital control	Chennai, India
15	2019	Andre Rusli1, Dareen Kusuma Halim	Towards an Integrated Hybrid Mobile Application for Smart Campus Using Location-Based Smart Notification	Experiment	Using Wi-Fi fingerprints to create a smart notification feature to reduce or even eliminate the risk of interruption overload that users of mobile applications frequently encounter due to the sheer quantity of notifications	Tokyo, Japan
16	2018 IEEE	XUESONG ZHAI YAN DONG , AND JING YUAN	Investigating Learners' Technology Engagement - A Perspective from Ubiquitous Game-based Learning in Smart Campus	Experiment	Investigation of factors and the driving mechanism to construct a learner's technology engagement (TE) model towards ubiquitous game-based learning (UGL) in the smart campus context.	Fuzhou, China
17	2016	S. Du, F. Meng, and B. Gao	RESEARCH ON THE APPLICATION SYSTEM OF SMART CAMPUS IN THE CONTEXT OF SMART CITY	Experiment	To demonstrate how the smart campus application system's design and implementation encourage the building of	Kerala, India

				school information and considerably improves the school's administration and service capabilities.	
18	2017	SMART CONNECTED CAMPUS	Experiment	To provide absolute information on smart campus	DOI: 10.1109/ICICICT1.2017.8342808

2.3 Search for academic performance publications

In our search for the academic performance publications, we focused more on academic performance as the search keyword as we formulated various search questions to help us find the appropriate publications. The search questions were *student academic performance prediction, prediction of academic performance for students, academic performance prediction, and what is academic performance?* We have also provided the various years and databases for every publication selection made in the accompanying table 3 and we used the google search engine for the search.

2.4 Publication selection

Our publication selection was an open one because we were interested only in any publication that has to do with academic performance regardless of the year of publication, methodology, and database. We were able to select 8 publications for us to consider the determinant index for predicting academic performance. Table 3 below shows the list of all the selected publications with the year of publication, journal database, names of the authors, the title of the publication, purpose of the research work, and parametric considerations.

Table 3: Some Academic Performance Publications

S/N	YEAR PUB & Journal	AUTHOR	Title	Purpose	Parametric consideration(s)
1	2018, IEEE	Raza Hasan, Sellappan Palaniappan, Abdul Raf EZ Abdul Razif, Salman Mahmood, and Kamal Uddin Sarker	Student Academic Performance Prediction by using Decision Tree Algorithm	To forecast a student's academic success	Academic Information (Current Grade Point Average) for Students (CGPA) The amount of time a student spends on his or her studies

2	2016, Science Direct	Hashmia Hamsa, Simi Indiradevi, and Jubilant J. Kizhakkethottam	Student Academic Performance Prediction Model Using Decision Tree and Fuzzy Genetic Algorithm	To create a model for predicting a student's academic achievement.	Internal marks, sessional marks, and the admission score are all factors to consider.
3	2015, Science Direct	Amirah Mohamed Shahiri , Wahidah Husain , and Nur'aini Abdul Rashid	A Review on Predicting Student's Performance using Data Mining Techniques	To give an overview of the data mining approaches used to forecast student success	Accuracy of prediction technique.
4	2020, International Journal of Educational Technology in Higher Education (Springer)	Eyman Alyahyan and Dilek Düştegör	Predicting academic success in higher education: literature review and best practices	To give educators a step-by-step set of instructions for using data mining approaches to predict student performance.	The accuracy of the categorization issues' measures.
5	2019, International Journal of Emerging Technologies in Learning (iJET)	Imran, Muhammed, Latif, Shahzad, Meymood, Danish, Shak, Muhammad Saglain	Student Academic Performance Prediction using Supervised Learning Techniques	To demonstrate the significance of data pretreatment and algorithm finetuning tasks in resolving data quality concerns	Student performance data, including grades, demographics, social factors, and school-related information
6	2017, Journal of Applied Research in Higher Education	Olugbenga Wilson Adejo and Thomas Connolly	Using a multi-model heterogeneous ensemble technique to predict student academic achievement	To test and compare the effectiveness of using several data sources, different classifiers, and ensembles of classifiers in predicting student academic success.	student records and Learning Management system
7	2021, IEEE	D.K Arun, V. Namratha, B.V.	Student Academic Performance	demonstrating the enormous	Subject grade and GPA

		Ramyashree, Yashita P. Jain, and Antara Roy Choudhury	Prediction using Educational Data Mining	potential of data mining applications for university administration and avoiding students from receiving a low GPA (GPA).	
8	2020, International Journal of Innovation and Economic Development	Alisa Bilal Zorić	Predicting Students' Academic Performance Based on Enrolment Data	Using a neural network, forecast students' academic success based on enrolling data.	GPA

2.5 Paper Analysis on Academic Performance

2.5.1 Factors of Academic Performance

When we try to measure the academic performance of students, we have to take cognizance of other factors that play roles in the learning process of students. When various students in the same institution have been gathered for academic performance tests, no matter the indices employed in the test, research works have shown that other considered intrinsic or extrinsic factors did affect the results obtained from such a test. Some of these factors were considered in this work as components of either of the two major categories of the factors that affect academic performance.

1 ***Intrinsic factor –***

a) Quality Time of Study – In this component, it does specify the amount of time that a student invested in his/her personal study with the sole purpose to learn. Various works have shown that most students are currently Nga *et al*, (2016) being faced with the confrontation of an environment that is constantly and rapidly changing as a result of technological advancement. These emerging technologies impedes on the time allocated to studies thereby making students to be spending more time in non-academic related activities (Nga *et al*, 2016; Olebara *et al.*,2021) (Social media, entertainment, and networking) which invariably have negatively impacted their academic performances. While considering the presence of a student in social media, Olebara *et al.*, (2021) students with a high presence in social media have a lesser likelihood of achieving good academic performance than those with less presence in social media activities. This also means that as long as social media tends to negatively affect students' academic performances, (Kleijn and Ploeg, 1994) time allotted to academic activities is negligible to impact positively on their academic performance due to time mismanagement habits.

b) Study skills and behavior - Study skills and behavior have to do with the strategies or capabilities developed that can be applied to learning. They are generally employed to ensure the achievement of success in school while considering more especially the acquisition of good grades. These skills such as (Shahzadi and Ahmad, 2011)

using information resources, taking class notes, communicating with teachers, preparing for and taking exams, and a variety of other learning skills (Shahzadi and Ahmad, 2011; Alyahyan and Düştegör, 2020) take time to be developed but once developed, they are beneficial throughout one's life. Because it has been demonstrated that (Soares *et al*, 2009) a strong association exists between study attitudes and academic achievements in higher education, learning skill is a factor that should not be overlooked in forecasting students' academic performance. Nonetheless, the findings of the study can be generalized to other educational institutions because students who can construct their study aids spend more time studying while creating them than those who rely on existing ones. This is because the process of compiling these studies appears to be lengthy.

c) Temperament - Temperament can be seen as someone's natural inclination that contributes greatly to patterning the person's behavior. Because it has to do with behavior, (Buckley, 2021) it can as well mean it is being formed from infancy and does not easlly change. By implication, it is being developed gradually over time and it is a factor that helps in discovering personality traits in people. Temperament has been a child's behavioral style (Thomas and Chess, 1977), individual variances in reactivity and self-regulation (Nga *et al*, 2016) restricted or unrestrained response to novelty, (Olebara *et al*, 2021) and patterns of emotionality, activity, and sociability (Kleijn and Ploeg, 1994) are all examples of concepts. Given this, the "*how*" of a person's academic performances can be said to relate with the person's style of behavior as shown typically in a classroom, and the way s/he responds both to other people that are involved in that person's learning environment and to the tasks required of him to achieve. Research work has equally proved that (Chess, 1968) the temperament of a person plays a significant role in how the person functions in school because it affects both how the person gets involved in the learning task and how s/he interacts with fellow students and teachers. Succinctly put, for a child to do well academically the child's temperament ought to be known and considered because it has been revealed that (Chess, 1968; Nasvytiene˙ and Lazdauskas, 2021) a child makes an improvement in school achievements and learns optimally when the demands placed on him or her is in consonant with his or her temperamental style and with his or her natural inclinations. In other words, learning can be impaired when the demands are contrary and become sources of stress.

2 ***Extrinsic Factor*** –

a) Family Background – The family background deals with someone's originalities and the foundation upon which individuals begin to build and it is also (Li and Qiu, 2018) the primary and most significant environment that every child is exposed to. One can then possibly link most of the intrinsic factors inherent in people to their backgrounds, especially the family. The intent of most families is for their children to make them happy and as such, any nation or people regards education as the basic platform or mechanism that enhances the quality of life in its entirety. Families, therefore, are committed to giving their children sound education from early stage in life as a foundation and contribution to the nation's building. This is because (Li and Qiu, 2018) childhood education is foundational to the formation and shaping of human labor-force quality, the capacity of innovation to determine the potentiality of the development of any nation. There are three (3) variables that have been considered to influence family background, they are (Li and Qiu, 2018) *social-economic status*, *academic*

status, and *cultural descent*. The economic status determines the capacity of the family to provide resources that enhance learning in the home and register their children in the best schools with the best teachers and resources. In a situation where the family does not have the wherewithal to provide learning amenities and conditions, the academic achievements of the children will be weakened. Considering the academic status of the family, (Idris *et al*, 2020) there is an establishment that there is a relationship between someone's academic achievement and the family's academic status. The reason is that educated parents have already acquired experiences in the process of academic excellence thereby possessing the capacity to provide good academic mentorship to their children. These experiences help an individual to readjust while building a solid academic life. Concerning people's cultural descent, there is a positive connection between culture and academic performance. While considering how cultural background can affect both learning and academic performances, (Lynch, 2016) several theories attempt to explain why different racial and ethnic groups perform differently in school. Three (3) of these theories (cultural deficit theory, expectation theory, and cultural difference theory) have been used. According to (Lynch, 2016), the cultural deficit idea focuses on the absence of suitable linguistic, social, and cultural nature required for learning in school environments, which leads to mistakes in skills, knowledge, and behavior that contribute to poor school performance. The expectation theory, on the other hand, is based on the idea that people perform in response to the expectations imposed on them. It focuses on how teachers treat students according to the expectations imposed on them in terms of academic performance.

b) Available Learning Resources - Learning resources can be seen as provisions of facilities that have been put in place to enhance learning for the derivation of knowledge. The purpose of these resources is to give people a common context and shared experience that can be discussed and debated, they are being provided based on the situational goals and level of challenge presented. Only professional teachers on a general note decide what is best for the specific students, situations, demographics, and environments that they work in. The conditions that ought to drive the provision of learning resources (Okongo *et al*, 2015) should accommodate all learners regardless of their physical, intellectual, social, emotional, and linguistic challenges. Learning resources can be grouped into tangible and intangible resources. The tangible resources include (Oyugi and Nyaga, 2010) human (teachers and support staff) and materials (Libraries, classrooms, books, multimedia facilities, and teaching aids). In the case of intangible resources, we have(Oyugi and Nyaga, 2010; Owoko, 2009) rendered services, time for rendering the service, the knowledge and skills of the human resource, and experience acquired during training and servicing. It has also been established that (Otieno and Yara, 2010) making teaching/learning resources available enhances the effectiveness of schools because these are basic things that facilitate good academic performance in the students.

c) Teaching Approach – The teaching approach can be viewed as the way the teacher sees teaching and learning which most times is guided by certain principles, beliefs, and ideas that prevail over the teacher. An approach the teacher adopts also (Hoque, 2016) gives rise to the methods, the way of impartation of knowledge of something through class activities or techniques to help learners learn the subject matter. It

should also be considered that whatever approach the teacher would adopt, comes from the intrinsic nature of the teacher, learning approaches, and ways of understanding which might not apply to some members of the class. As a result, adopting a generalized approach towards teaching without considering individualistic peculiarities would not determine a student's academic performance. It is so because it would not address the needs of the student and peculiarities such as temperaments if ignored while teaching (Nasvytienė and Lazdauskas, 2021) might lead to the student's frustration in learning. Such a student develops a defensive strategy towards learning which most of the time leads to the misinterpretation of the student's feelings (the frustration) as disobedience or stubbornness. Since teaching is a (Isa *et al.,* 2020) profession that has to do with the impartation of knowledge or skill to a learner, the transfer of knowledge then requires the effective (Isa *et al.,* 2020) utilization of the most appropriate approach and pedagogy for the learner, the objectives and expected outcomes. Based on this, the bulk of students' inability to learn while teaching can be attributed to teachers' use of ineffective teaching methods.

3.0 Result and Discussion

The table 4 below shows the aspect of the campus that the researcher(s) intend to demonstrate how smart technology can be effectively utilized. These aspects have been majorly categorized into *Infrastructure, Academic oriented, Resource management,* and *Governance*.

Table 4: Summary of table 2 based on the purpose for the publication

Category	S/N involved	Number
Infrastructure	1,3,4,7,8,10, and 12	7
Academic Oriented	2,5,6,16, and 17	5
Resource Management	2,13,14,15,17,18, and 9	7
Governance	11	1

Table 5: Summary of table 3 based on parametric considerations

Parametric Consideration	S/N involved	Number
Cumulative Grade Point (CGP)	1,7, and 8	3
Accuracy of prediction technique or measures used in the classification problems.	3 and 4	2
Score or grade	2 and 5	2
Hours spent studying	1 and 6	2

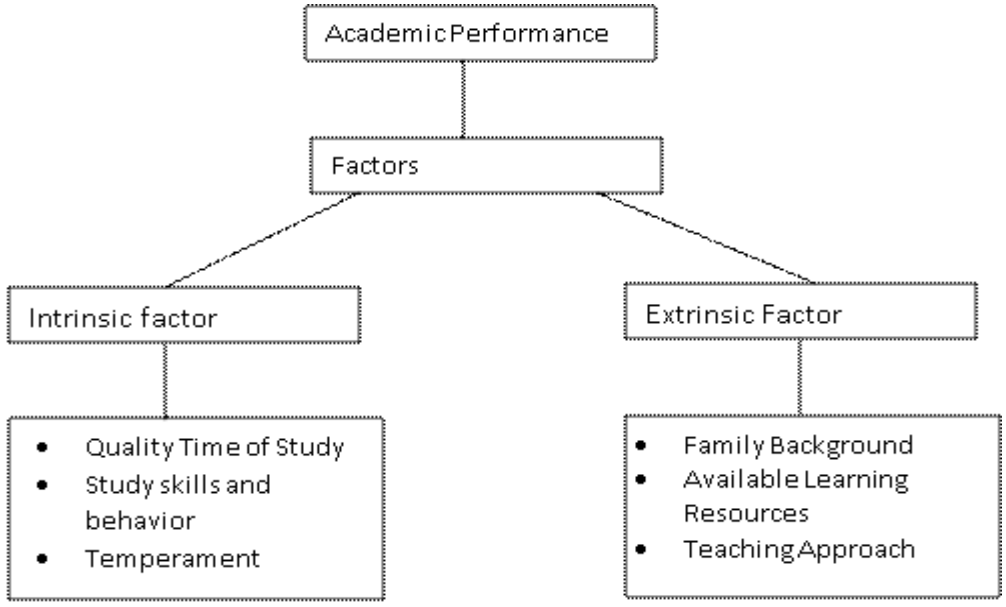

Fig. 1: Relationship between academic performance and factors of Academic performance

In Table 1 above, we provided various domains where the effect of smart technologies can be utilized in a smart campus and they include iLearning, iManagement, iSocial, iGovernance, iGreen, and iHealth. The idea of the smart campus was to provide help for the improvement of the academic performances of students. Academic institutions are interested in the academic performance of students because it is one of the parameters that rank the performance of institutions. In Table 2, we have a list that shows some of the works on smart campuses, the greater number of the works show that schools in Asia embraced smart campuses and desire to improve on them. Table 4 shows our findings in table 2, our interest was on the purpose of the research so that we can understand the problem(s) being addressed. We then categorized the purposes for the publications to fit into *Infrastructure*, *Academic oriented*, *Resource Management*, and *Governance* to holistically capture interests of issues that can disorganize academic activities on campus. From the results, works targeted at the infrastructure and resource management were more in number, followed by academically oriented works, and then the least was on governance.

In Table 3, we provided a list of some publications on academic performance, table 5 originated from our findings regarding academic performance. We discovered that many researchers focused more on using CGP(A), sometimes score would be used to determine the academic performance of students. These things are ideal but should not also ignore that whatever CGP(A) or even score a student gets has factors that have contributed to them. Figure 1 shows that in learning, both intrinsic and extrinsic factors prevail all the time. We have also found that whenever a student is favoured by extrinsic factors, the student's academic performance tends to be better than the student who was not favoured.

4.0 Conclusion

The academic performance of any student shows how well a student learns from any academic environment and it also shows how good any institution is academically. Every student in a particular school might not be at the same level of academic performance because they all do not have the same intrinsic and extrinsic factors. Predicting the academic performance of students can be of help to the learner and the educator, to improve on the learning and teaching

processes respectively. A survey on previous studies on smart campus and predicting students' academic performance shows that most of the researchers used cumulative grade point (average) (CGP(A)) and scores to determine academic performances.

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Ezugwu Assumpta did a survey on Smart campus publications ranging 2000 – 2005 then made selections of the required publications for this work. She also contributed part of the review of related works.

Nweke Onyinye on her part did a survey of publications on Smart campus ranging 2006 – 2013 in order to select publications for this work. She equally contributed in the introduction and the review of related works, and research framework.

Aneke Stephen contributed in the publication survey ranging 2014 – 2021, part of the introduction, research methodology and analysis.