

# Bring Your Own Device (BYOD) to the Classroom: A technology to promote Green Education

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**Abstract**— The “bring your own device” (BYOD) is the concept of encouraging people for bringing their own devices to work or study and is gaining popularity in both corporate and educational environments. The concept of BYOD is particularly beneficial for the education sector due to cost saving, comfort of using personal devices and above all promotes green learning. The colleges and universities have been adapting their networks and policies to accommodate personal mobile computing devices for quite some time. Since the time laptops became affordable and smartphones and tabs are a common possession, undergraduate and graduate students have been bringing their own devices to campus. They expect their institutions to provide ever-present, reliable wireless connectivity for all of their devices. These devices not only make learning and accessing information easier but it also enables the college/ school to save the cost of providing computing devices to students and faculty. Another aspect of BYOD that we have tried to explore in this paper is its role in promoting green learning. Green learning means learning that supports green computing. Higher education leaders are now revamping their IT strategies in order to meet the expectations of anytime, anywhere internet access and technology based learning. Many institutions need to upgrade their network capacity and performance by increasing bandwidth, adding access points, boosting their network management capabilities and addressing security concerns. The institutions also need to develop a learning platform suitable to support Bring Your Own Device (BYOD). Institutions that are proactive in their approach towards BYOD will stand a chance to gain critical benefits from its implementation. If faculty can integrate technology into their teaching methodology, they’ll see improvements in student participation, collaboration and learning outcomes.

**Keywords**— *BYOD, Green Computing, Green Learning, Higher Education Technology*

## I. INTRODUCTION

Bring your own device (BYOD) is the concept of encouraging people to bring and use their own devices at work. It has become a popular term in the corporate world and more and more employees are bringing their personal devices like laptops, smartphones and tablets to work or use them remotely to access corporate information [1]. BYOD empowers the employees by giving them the flexibility to work anywhere and whenever they want and on the device of their choice. Various surveys show that this makes the employees are more productive, interactive and satisfied.

In this generation of highly technologically advanced workforce, the employees demand a greater flexibility in how, when and where they can work and access data and information. With the ability to use their own device, people can be more productive at any time and from any place on their preferred smartphone, tablet or notebook. [4]

Organizations are either utilizing their existing IT infrastructure or implementing software-as-a-service (SaaS) apps to support the secure and efficient execution of a BYOD policy. If the implementation of BYOD is done in the right manner, it maintains data privacy and also ensures the security of sensitive business information. Another advantage is that there is no need for a large IT team for device provisioning and maintenance and the IT department can instead focus on offering secure services, secure access to virtual desktops and apps, and cloud-based services. This is possible because people will naturally take better care of their own devices and have a better understanding of its full capabilities. Not only does this reduce the reliance on IT support, it enables organizations to set and achieve cost saving targets, including reducing device procurement costs and support expenses. [4]

Bring Your Own Device (BYOD) in the classroom means that the students will carry their own devices like laptops, tablets and smartphones to the class and use their own devices instead of depending on the devices provided by the school/ college. The adoption of bring your own device in the education sector can be motivated by two factors. One factor is cost cutting and the second one is adaptation of technology. The cost saving due to students bringing their own devices is a big factor to motivate the educational institutes to promote BYOD. The second factor of technology adoption is equally important. We are promoting usage of technology and also this leads to green education. It is always easier to keep a track of studies if using the same device in school and home. The concept of Bring Your Own Device is already very popular in the business sector and its advantages have been well understood. Now, a number of educational institutions are considering BYOD due to the benefits it can offer to classroom learning. Bring Your Own Device is a relatively new trend and its advantages and disadvantages are being explored to understand its implementation in both the business and education sectors. On one hand, BYOD brings many benefits to the effective classroom learning, but there are many concerns associated with its implementation that leave many educational institutions pondering whether or not BYOD should actually be promoted.

BYOD has already been implemented in a number of educational institutions across the globe but, not without in-depth consideration beforehand with regard to the method of implementation. A solid BYOD policy begins with identification of the

issues that surround BYOD use in the classroom and by staff when outside the classroom. BYOD can work well in the education sector, provided we identify the benefits, challenges, drawbacks, and future implications of establishing a BYOD policy.

## II. LITERATURE REVIEW

The implementation of BYOD in the educational sector cannot be generalized as there are specific issues related to regulations by the governments and university systems which vary across different countries and regions. There are infrastructural requirements that have to be identified and implemented for an effective implementation of BYOD. There are financial constraints and internal rules and regulations of the educational institutions that need to be addressed. The literature review was conducted to analyze the requirements for implementing BYOD, its benefits and the possibility of introducing Green education. The main sources of study were the reports and articles from the internet related to implementation of BYOD in the educational sector in different countries.

Bring your own device (BYOD) is the concept of encouraging people to bring and use their own devices at work. It has become a popular term in the corporate world and more and more employees are bringing their personal devices like laptops, smartphones and tablets to work or use them remotely to access corporate information [4]. BYOD empowers the employees by giving them the flexibility to work anywhere and whenever they want and on the device of their choice (www.cognizant.com). Various surveys show that this makes the employees are more productive, interactive and satisfied [5].

In this generation of highly technologically advanced workforce, the employees demand a greater flexibility in how, when and where they can work and access data and information. With the ability to use their own device, people can be more productive at any time and from any place on their preferred smartphone, tablet or notebook. (Joseph Sweeney, 2012). If the implementation of BYOD is done in the right manner, it maintains data privacy and also ensures the security of sensitive business information. Another advantage is that there is no need for a large IT team for device provisioning and maintenance and the IT department can instead focus on offering secure services, secure access to virtual desktops and apps, and cloud-based services. [6].

## III. METHODOLOGY

This research is conducted on the basis of the observations and findings collected from various research reports and from interviews and discussions conducted between May 2017 and December 2017. The concept of BYOD is in its initial phases of adoption in India and its Implementation in the education sector is minimal. Even wherever the concept of BYOD exists, there is no proper policy for its implementation due to which the benefits of this policy are not being acknowledged.

While conducting this research, the advantages of implementing a BYOD policy were studied with a major focus on the possibility of introducing the concept of Green education where we have proposed certain recommendations for BYOD implementation which can make the process of teaching and learning support the environment. For this, various literatures on Green computing was studied and it was observed that with an effective implementation of BYOD we could contribute to Green computing as well [7].

In order to implement an effective BYOD policy in the classroom, the first requirement is to understand the needs of the faculty with respect to their teaching methodology and requirements for a class. For this purpose various meetings, both formal and informal were conducted and requirements were gathered on the basis of which the BYOD policy was proposed. Interaction was done with various peers involved in education sector to discuss ‘BYOD in Education,’ where a free exchange of knowledge, experiences, challenges and solutions took place, and where the peers could learn from each other.

The implementation of BYOD is not just about formulating policies but requires a strong technical support, therefore observations from both technical staff and educators were collected. The participants were interviewed in order to capture the issues which the participants thought were important to discuss with regard to the implementation of BYOD and the challenges around the key topics of device and software deployment in education were taken into consideration. The issues identified by the participants regarding the implementation of BYOD in education have been directly addressed in this study.

## IV. IMPLEMENTING A BYOD POLICY

The study conducted on the implementation of the BYOD policy in classroom has enabled us to gather the advantages of this policy with respect to the students, teachers and the school administration. A Bring Your Own Device (BYOD) policy means that students and staff are allowed to bring their own devices such as tablets, laptops, and smartphones for use within the classroom for learning activities and facilitating the faculty in preparing their lessons. The concept of BYOD has gained popularity in the corporate world and has been gaining acceptance in educational institutions as the potential benefits it offers have been identified [9]. If BYOD has to be implemented then the teachers have to make modifications in their teaching methodology, learn the tools and upgrade themselves. BYOD allows teachers to prepare lessons and keep all data and assignments in one location and then share the resources with students. Like the students, the teachers also carry their devices along with them and are free to prepare their classes anywhere and anytime.

Today's students are extremely technology friendly and use it for both leisure activities and learning. They find technology exciting and feel more close to their own devices than the ones available in computer labs. Since they are accustomed to the world of digital devices, they can better relate to a classroom environment that accommodates the devices that they are using all the time and it is the way they would prefer to learn once the BYOD is properly implemented.

BYOD helps the institutions in reducing the cost of IT infrastructure as students are bringing their own devices. By creating a BYOD policy that encourages the use of digital devices for learning, it creates an open atmosphere and promotes appropriate use of digital devices.

## V. PROPOSED MODEL FOR IMPLEMENTATION OF BYOD

The proposed model for implementation of BYOD in an educational scenario (Figure 1) can provide the access to learning resources both inside the campus and outside. To access the resources within the campus, a wireless network has been recommended and for accessing the resources outside the campus, internet is required to utilize the power of cloud storage. This BYOD model works in the following manner:

- Users both the students and faculty are allocated username and password which enables them to connect to the server where all the learning resources are stored.
- The user credentials are verified against a user database.
- Once verified, the user is connected to the server.
- The resources are replicated on a cloud through the internet from where the users can access them even from outside the campus.

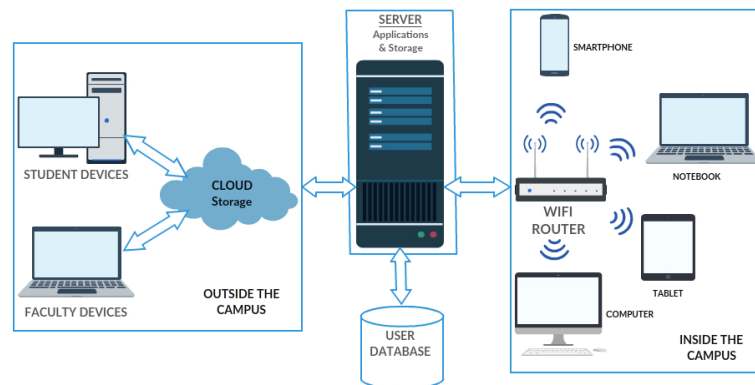


FIGURE 1: PROPOSED MODEL TO IMPLEMENT BYOD IN THE CLASSROOM

To implement a BYOD in a university campus, certain arrangements have to be made to provide the connectivity to the different devices. An effective way to implement this would be to set up an internal network that could support the devices. The learning system in a university campus can be set up using a MANET. A MANET consists of autonomous mobile nodes that are free to roam arbitrarily with no centralized controller such as router to determine the communication paths [11]. Each node in the ad hoc network has to rely on each other in order to forward packets. This kind of nature of MANET requires mobile nodes to have good cooperation with each other to ensure that the initiated data transmission process is a success. This network is independent of any fixed infrastructure or centralized administration. A node communicates directly with nodes within its wireless communication range. Nodes that are part of the MANET, but beyond each other's wireless range communicate using a multi-hop route through other nodes in the network. These multi-hop routes changes with the network topology and are determined using a routing protocol. A node in an IP-based network is configured with an IP address, a netmask and a default gateway (the node to which packets for destinations not having an explicit entry in the routing table are sent). In a MANET, nodes should be able to enter and leave the network at will. Thus, the nodes should be capable of being dynamically configured by the network upon their entry into it. It may be argued that MANET nodes also belong to some home network, and could continue to use their home network IP address in the MANET. However, in several instances a node does not permanently own an IP address: an IP address is assigned to the node when it boots up, and the node releases it on leaving the network. The use of MANETS provides two major advantages to the university:

- The cost of having a fixed infrastructure is saved.
- The users can join and leave the network at their will.

In case, the user, user1, is a computer science student. She is currently preparing for her class presentation on software engineering and that covers several topic areas. At a particular time, she is at the campus cafeteria. She has brought her laptop along so that she can continue working. Before leaving home, she has downloaded the PowerPoint slides on a specific topic onto her laptop. After working through a few slides, she comes across an annotation mentioning a paper that explains a specific aspect in more detail. User1 tells her laptop that it should try to locate the paper somewhere and download it. User1 laptop is not connected to a fixed network.

However, her laptop forms an ad-hoc network together with other nearby computers. Some of these computers (or rather their users) will have similar interests as User1 and might thus be able to provide the required information. Eventually User1 laptop finds another computer that not only possesses the paper in question but is also willing to allow downloading it. User1 works through the paper and then returns to the original slides. Even after going through all of them, she is not sure that she has quite understood the topic and feels that an example would greatly help her understanding. She asks the laptop to look for an example. It reports that while none of the computers currently participating in the ad-hoc network has stored the example, a computer that offers access to the fixed network has just joined. User1's laptop uses this computer's network connection to retrieve the example. Therefore, we have both the facilities at the campus and users can either use the information stored in other peoples' computers or can connect to the internet through the wireless network provided by the university. Thus we see here that using adhoc networks is a very useful method for implementing BYOD

## VI. THE BENEFITS OF A BYOD POLICY

A Bring Your Own Device (BYOD) policy means that students and staff are allowed to bring their own devices such as tablets, laptops, and smartphones for use within the classroom for learning activities and facilitating the faculty in preparing their lessons.

The concept of BYOD has gained popularity in the corporate world and has been gaining acceptance in educational institutions as the potential benefits it offers have been identified [9]. Some of the benefits of using BYOD in education sector have been listed below:

#### 1. Hybrid Learning

According to Wikipedia “Hybrid/ Blended learning is an education program (formal or informal) that combines online digital media with traditional classroom methods. It requires the physical presence of both teacher and student, with some element of student control over time, place, path, or pace.” BYOD enables the students to use their devices in the classroom. Being able to use devices like laptops in the classroom instead of just the computer lab provides a fully integrated learning experience for students. The teachers have to learn and use the digital teaching tools and it is a learning experience for them too. Digital devices along with digital learning tools provide a blended learning experience where students have access to educational data, interactive textbooks, online videos, research sources, and the capability to collaborate in the classroom environment with peers and the teacher.

#### 2. Learning and upgradation of faculty

If BYOD has to be implemented then the teachers have to make modifications in their teaching methodology, learn the tools and upgrade themselves. BYOD allows teachers to prepare lessons and keep all data and assignments in one location and then share the resources with students. Like the students, the teachers also carry their devices along with them and are free to prepare their classes anywhere and anytime. They not only use the devices to prepare the lessons to meet the curriculum requirements but can also prepare reports, track student progress, send notes to students and much more.

#### 3. Student Association with Technology

Today’s students are extremely technology friendly and use it for both leisure activities and learning. They find technology exciting and feel more close to their own devices than the ones available in computer labs. Since they are accustomed to the world of digital devices, they can better relate to a classroom environment that accommodates the devices that they are using all the time and it is the way they would prefer to learn once the BYOD is properly implemented.

#### 4. Preparing the future workforce

BYOD inculcates within the students that technology is not just about leisure and entertainment but it is about professional use and learning. These students of today are going to be professionals of tomorrow and would be required to use technology wherever they work regardless of whether they work for a company, start their own business, or go for further studies, technology is all around them. By using technology in the classroom, it better prepares the students for the outside world.

#### 5. Benefits to the school administration

The higher educational sector is looking for a method to implement the highest and latest learning standards in limited budget. BYOD helps the institutions in reducing the cost of IT infrastructure as students are bringing their own devices. BYOD can help to close the gap between low income students that cannot afford their own device and upper income students that bring their device. Schools can provide vouchers or purchase enough digital devices to meet the needs of low income students while the remainder of the students can use their own device. By creating a BYOD policy that encourages the use of digital devices for learning, it creates an open atmosphere and promotes appropriate use of digital devices.

### VII. BYOD FOR GREEN EDUCATION

Green Informatics or Green Computing is a common term in ICT that describes the utilization of information and communication technology in the interest of the natural environment and the natural resources to promote sustainability and sustainable development (Center for Sustainable Systems, 2011). Green computing is the environmentally responsible and eco-friendly use of computers and their resources. By using BYOD policy, institutions can support green education in the following ways:

#### 1. Reduction in the total number of devices being used

Almost all students at graduate and under graduate levels own a laptop today. Even if the college lab has desktops, most of the students carry their own laptops to college for various reasons. If BYOD policy is implemented, instead of using two devices, every student is using just one device. This directly halves the number of devices being used and helps in huge amount of energy conservation. This is a direct contribution to the green computing and is a green learning initiative.

#### 2. Reduction in usage of paper and printing

The teaching material and other data to be shared with students are saved on either a centralized server or the cloud. The students can access this data directly through their devices. In this case there is no requirement to provide printed notes to every student. This not only makes the task of information sharing easier but saves huge amount of paper. Saving printed paper is a big support to environment and leads to green learning.

#### 3. Limiting the number of devices discarded

If the devices are not owned by people, they tend to be more careless when using them. This is the reason that the computers used in the labs of schools and colleges need regular maintenance and have to be replaced frequently. The discarding of devices is a big environmental concern as there is a big question mark on their disposal. If students are bringing their own devices, they will be careful in using them and the number of devices discarded will be limited. This is again a support to environment and leads to green learning.



**VIII. CONCLUSION AND IMPLICATIONS**

The infusion of personal portable computing devices like laptops, tablets and smartphones into our daily lives has brought a revolution in the process of how we communicate with the world and access information. The inception of these devices along with the mobile communication technologies like 4G makes the information revolution even more powerful and omnipresent in the lives of students and professionals alike. The education sector is currently experiencing the introduction of a digital wave that has a bright future ahead for technology based classroom learning. Bring your own device (BYOD) is a policy that brings the students closer to technology and makes them understand that the digital revolution is not just about social networking and entertainment but it is much more important to enhance the learning and knowledge sharing process. It is important to teach the students how to effectively implement current technologies for their own betterment and for the betterment of the society and nation. By acknowledging the importance of mobile devices and other digital technology for the students, the education sector is laying the foundation for a technologically sound workforce for the world. But the responsibility of the education sector is not limited to teaching the students how to use technology but a bigger responsibility is teaching them the importance of using the technology responsibly and also to contribute to conservation of environment in the best possible way. Though the devices we are talking about have made the learning process simpler but we should not be adding to the carbon print and should be focused on reducing it. Practicing BYOD can lay the foundation of Green education and as educationists it is our responsibility to make sure that this becomes a reality.

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