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Editorial Note

It is a matter of great vanity and pleasure that Prime University published the current issue of Prime University Journal (PUJ). Prime University Journal is an International Journal published half-yearly (January-June and July-December). It is a scholarly peer reviewed journal designed for research communities to promote a strong platform for professional growth, foster collaborations, and academic excellence in the field of science, engineering and technology, business, law, literature, life science, society and culture.

Six research articles on multidisciplinary issues have been selected in the current volume.

The *first* article is designed to develop a robotic vehicle using an Android application for remote operation attached to a wireless camera. The article innovates the ability to adapt and optimize video transmission in real-time, ensuring uninterrupted and low-latency surveillance capabilities at any bandwidth.

The *second* one attempts to study Toni Morrison's *The Bluest Eye* (1970) in the light of *Dear Ijeawele or a Feminist Manifesto in Fifteen Suggestions* (2017). This article delves into details of the analysis of *The Bluest Eye* in the light of *Dear Ijeawele*.

The *third* article analyzes the importance of technology in education; finds out prospects & challenges of using technology and attempts to focus on removing all barriers to the use of educational technology so that it can secure a suitable platform in education of Bangladesh.

The *fourth* study aims to thoroughly examine the narrative tactics utilized by Virginia Woolf in her influential novel *To the Lighthouse*. Using ideas from well-known literary critics and scholars it aims to clarify the complexities of Woolf's narrative experimentation and how it affects literary discourse.

The *fifth* one is an attempt to predict the compressive strength of concrete incorporated with recycled aggregates like rubber aggregates, fly ash, rice-husk ash, stone dust, etc. It aims to develop more reasonable strength models that will help to know the concrete strength on site.

The *last* article explores the state of Madrasah education in Rajbari district, specifically examining the utilization of ICT in teaching and learning practices.

Finally, I extend my heartfelt gratitude to the patrons of the journal. I also express my sincere thanks to the advisors, members of the editorial board and the contributors of the journal. I hope this volume will be useful and valuable for academics and the society.

Prof. Dr. Abdur Rahman
Chief Editor, Prime University Journal
And Vice Chancellor (acting)

Contents

Design and Implementation of Wireless Surveillance Robot for Real-time Video Monitoring

Md. Nazmul Islam[1], Sunirmal Kumar Biswas[2] and **Md. Mostak Ahmed[3]**

***Abstract*:** Robotics and automation are widely used technologies around the world because of their simplicity and ability to be modified to meet changing needs in modern life. This research is designed to develop a robotic vehicle that uses an android application for remote operation attached to a wireless camera for monitoring purposes. This robot is engineered to operate seamlessly without delay and maintain an optimum frame rate under varying bandwidth conditions. The development of this robotic system addresses the critical need for real-time, high-quality video surveillance in diverse environments. The core innovation of this research lies in its ability to adapt and optimize video transmission in real-time, ensuring uninterrupted and low-latency surveillance capabilities at any bandwidth. The features of the system include transmission techniques that dynamically adjust frame rate to match available bandwidth. This adaptability ensures consistent video quality, even in low-bandwidth scenarios. The construction and testing of the wireless video surveillance robot have demonstrated its effectiveness across a range of practical scenarios, from indoor facilities to outdoor areas with limited connectivity. The results indicate that the system consistently achieves optimum frame rates without introducing delays, making it a valuable tool for applications such as security monitoring, remote inspection, and surveillance in dynamic environments. The robot integrates advanced intelligent algorithms to achieve this goal.

Keywords: Bandwidth, Frame Rate, Buffer Delay, Surveillance, Wi-Fi, Robot

Introduction

A robot is a machine that can perform a series of complex actions automatically, especially one that can be programmed by a computer. Wireless communication is crucial in many robotic applications, making

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robotic systems more efficient and compact while reducing the risk of errors. This makes robots suitable for use in industries where even a small mistake can lead to significant problems. By using robots, labour costs in certain sectors can be reduced considerably. Nowadays, many countries are using robots to support their soldiers on the battlefield. Robots can also be used for removing landmines and serving as ideal soldiers. Mobile robots are not fixed to one location, and they can move around freely in their environment (Hasan et.al, 2018).

Video surveillance is the process of monitoring a situation, an area, or a person (Kumar et.al 2016). This generally occurs in a military scenario where borderlines and enemy territory surveillance are essential to a country's safety. Human surveillance is achieved by deploying personnel near sensitive areas to constantly monitor for changes. But humans have limitations, and deployment in inaccessible places is not always possible. The wireless system has undergone rapid development in recent years. Communication without wiring makes a control system very compact and robust. Wireless video surveillance robot is an IoT-based technology that makes surveillance deployment possible in even remotely inaccessible areas where it is almost impossible for humans to reach. Even if the reach is possible, some areas are way too risky to be camped in by humans (Li et.al, 2016).

Furthermore, wireless technology reduces maintenance complexity and costs. When a real-time video camera is mounted on this type of robot can send images instantly to the operation section through internet which is largely dependent on the internet speed. Internet speed must be high enough to transfer data efficiently (Garrett et.al, 2018 & Lehner et.al, 2017).

In 2017, some researchers introduced a long-range Internet-connected robot tele-operation system based on IoT, which allows operators to remotely control robotic systems even when the connection with the on-board receivers is lost due to line-of-sight issues or device damages. Their system can be used to control mobile robots without range barriers as long as both the robot and the remote control device are connected to the Internet. The proposed tele-operating system can be used on any device with an Internet connection to control robots of any type, including wheeled, aerial, and humanoid robots. It also has potential applications in non-robotic domains. The system architecture includes a Pioneer 3AT mobile robot connected to a notebook computer via a USB-serial port, with a three-layer architecture developed in ROS to manage motor drivers and sensors. The notebook is connected to the Internet via a 4G modem (Uddin et.al, 2017).
Furthermore, the development of an Internet remote control interface for a MITSUBISHI PA10-6CE manipulator, which includes a TCP/IP server for command parsing and execution, and a client Java applet web-site for robot

control The forward and inverse kinematics algorithms are employed for determining the position and orientation of the manipulator's end-effector in Cartesian space. A path-planning algorithm based on 3rd order polynomials is implemented to achieve smooth motion of the robotic arm. Safety features are incorporated, such as a simple algorithm based on forward kinematics to prevent the arm from entering forbidden areas, and network watchdogs to improve robustness (Wronka et.al, 2006).

In this study, we have developed a robot that can be used for video surveillance and can be controlled through a GUI interface. The control mechanism is provided with a video transmission facility. Video transmission is practically achieved through high-speed image transmission. Initially, the robot is equipped with a camera to capture scenes and transfer the images to the server, where the user can control and watch the live feed. The wireless video surveillance robot is built with the help of ESP32-CAM and has a wireless range of up to 200 meters. Wireless systems have undergone rapid development in recent years. Communication without wiring makes a control system very compact and robust.

Methodology

The data transfer rate is inversely proportional to the frame rate of video and quality of video is proportional to the frame rate. So, we cannot get high data transfer rate and high quality video at a time. We develop a technique that able to give us optimum data transfer rate at optimum video quality. In this paper, we design the wireless video surveillance robot using ESP32 CAM , which can perform the following steps:

Firstly, we power the ESP32 CAM and connect it with Wi-Fi. If all of them are work properly, then measure the bandwidth and frame rate and make a decision based on predefine frame rate for specific bandwidth. At the same time, this system can receive some command for car movement and execute it. This system transfers video data at maximum frame rate for any bandwidth without any buffering delay. This means the receiver gets continuous video even if the bandwidth is very poor.

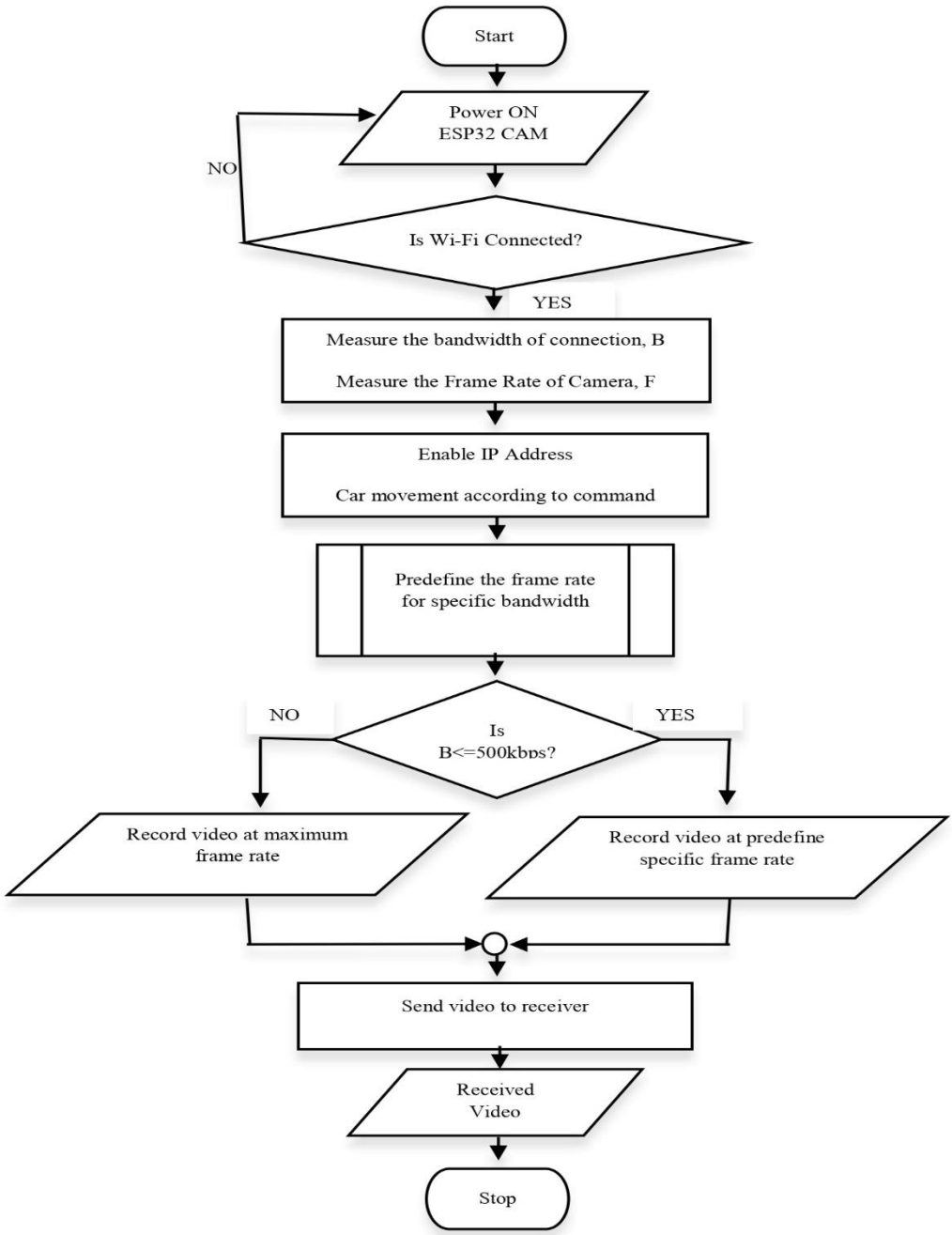

Figure 1: Flowchart of buffer free optimum frame rated Wireless video Surveillance robot using ESP32-CAM

Block Diagram:

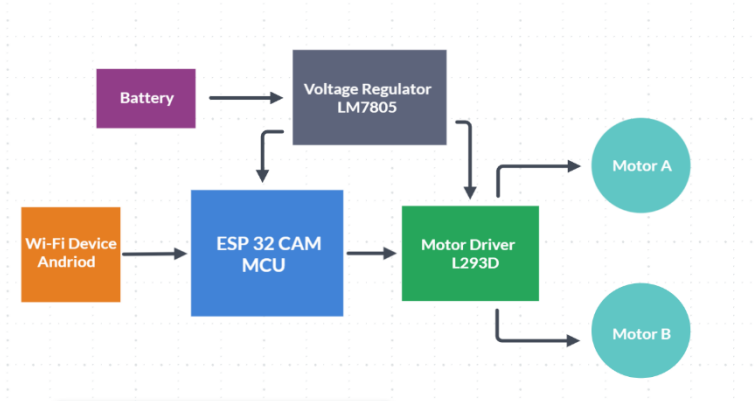

Figure 2: Block diagram

Circuit Diagram

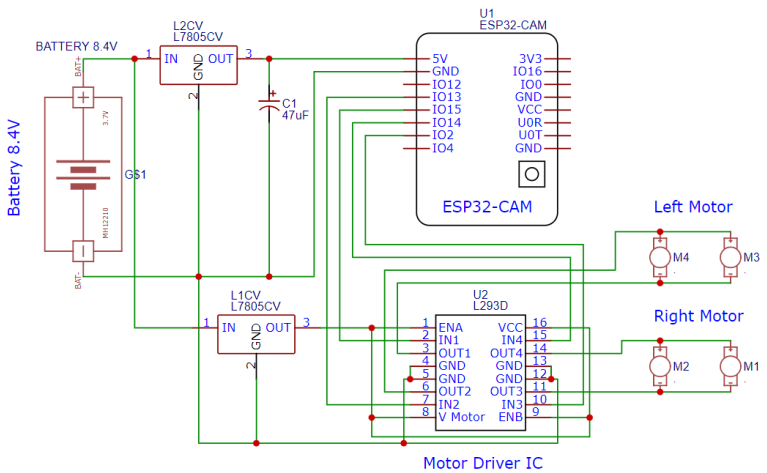

Figure 3: Circuit diagram

Working Principle

The working principle of this smart surveillance robot is to operate in places where human movement is not possible. Figure 02 shows the circuit diagram of a wireless video surveillance robot. Here we used the ESP32 board for processing Wi-Fi and camera control. This is a 32-bit microcontroller with built-in Wi-Fi. The Wi-Fi connects to with a smartphone and obtains the IP address (192.168.4.1). Enter this IP address in any browser to access the control webpage. The webpage designed for

the control car's left, right, forward, backward, and ESP32 LED Flash control. When any button on a webpage is pressed, the ESP32 receives a signal from Wi-Fi, processes the signal, and sends it to the motor driver IC for car movement. Car movement is driven by a four-gear motor, which operates based on signals received from the webpage. LED flasher control using a PWM signal Flasher needs to be used for steaming video in low-light or night mode. Firstly, the system observes the bandwidth condition of the user and decides for the appropriate frame rate and command to the processor. Then, the processor makes a signal for the camera module to record video at the appropriate frame rate for any environmental condition. After that, video streaming always runs on a webpage.

Result and Discussion

In the Bandwidth vs Frame Rate curve, we are examining how the available bandwidth (measured in Kbps) varies concerning the frame rate (measured in frames per second, f/s). The curve shows that as the available bandwidth increases, the general frame rate increases. For high frame-rate data transfer without any buffer delay requires high bandwidth and low-frame-rate video (low quality) data transfer requires low bandwidth. It suggests that higher frame rates might lead to decreased data transfer speeds or quality due to limited available bandwidth. Therefore, we design an intelligent system that varies the frame rate (quality) of video with respective bandwidth to transfer data without any buffer delay.

Table-01: Image Transmission Frame Rate with Different Bandwidth

SL No.	Bandwidth (kbps)	Frame Rate	Buffer Delay
1	131	14.85	No Buffer [0]
2	130	14.02	No Buffer [0]
3	129	13.52	No Buffer [0]
4	127	13.46	No Buffer [0]
5	126	13.25	No Buffer [0]
6	120	12.27	No Buffer [0]
7	119	11.38	No Buffer [0]
8	94	6.42	No Buffer [0]

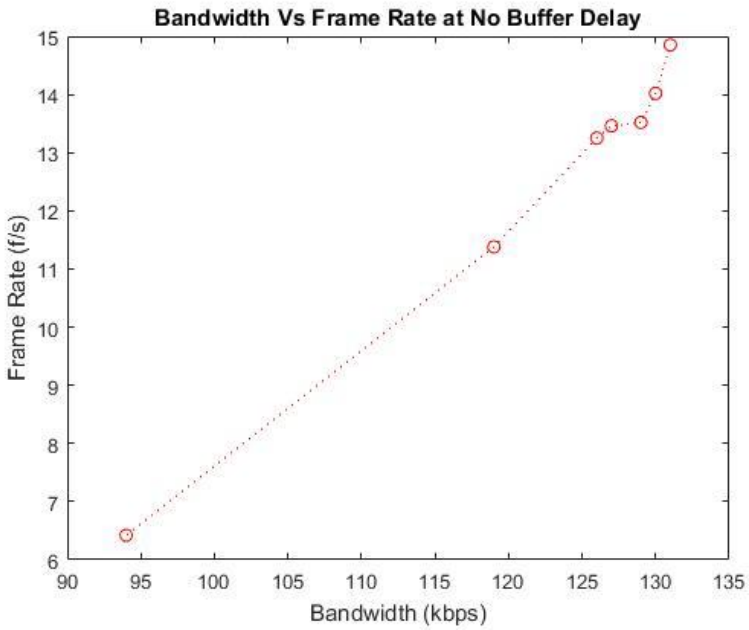

Figure 4: Bandwidth Vs Frame Rate

In the "Bandwidth vs Buffer Delay" curve, we are exploring how the available bandwidth relates to buffer delay (measured in milliseconds) at same quality video (13f/s).

Table-02: Buffer Delay with Different Bandwidth at 13 Frames per Second

SL No.	Bandwidth (kbps)	Frame Rate	Buffer Delay
1	131	13	No Buffer [0s]
2	130		No Buffer [0s]
3	129		No Buffer [0s]
4	127		No Buffer [0s]
5	126		0.975s
6	120		1.002s
7	119		1.32s
8	94		1.43s
9	90		Disconnected [let 2s]

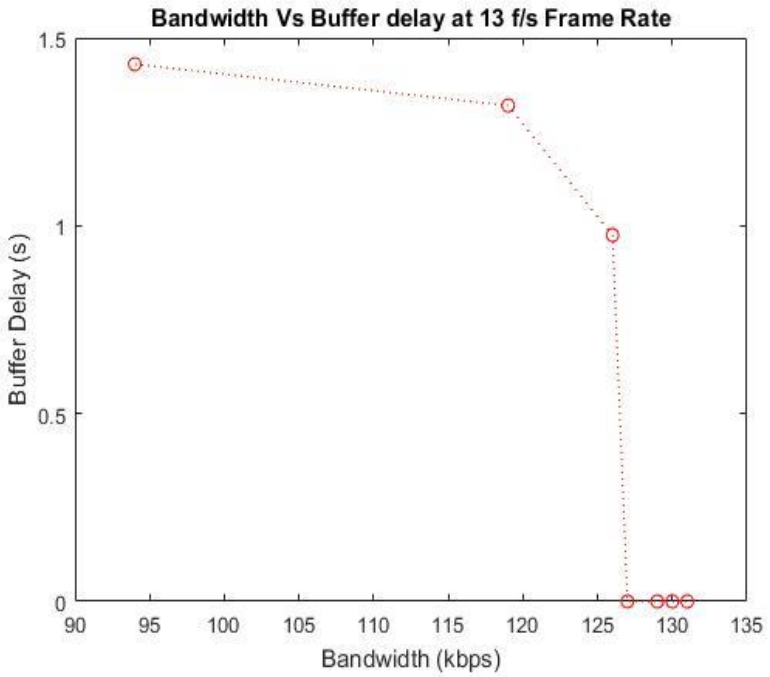

Figure-5: Bandwidth Vs Buffer delay at 13 Frames per Second

This curve clearly shows that as the available bandwidth increases, the buffer delay decreases for same quality video. For getting continues signal at available bandwidth we need to fix lower frame rate video which mean low quality video. From both curve above, it is clear that high quality (high frame rate) and delay less video transfer is occur at same time with our available bandwidth so we need to compromise either quality or delay. To solve this problem, we developed a new algorithm that ensures the possibility of optimum quality and buffer delay free transfer at any available bandwidth.

Conclusion

In this research, we have successfully implemented the workings of the wireless video surveillance robot. The main challenges in implementing this robot were the lower clock pulse of microcontroller, accuracy issue with the components and increasing control distance range. Despite these challenges and limitations, the preliminary model of the robot was successfully controlled from a long distance using webpages through wireless technology. In the bandwidth vs. frame rate curve, we observed that frame rate and bandwidth are closely related in video streaming and transmission. Increasing the frame rate generally requires more bandwidth, as shown in the curve.

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Critiquing Toni Morrison's *The Bluest Eye* from the Perspective of *Dear Ijeawele or a Feminist Manifesto in Fifteen Suggestions*

Mahbuba Sarker Shama[1]

Abstract: Toni Morrison's *The Bluest Eye* (1970) portrays Pecola, a minor girl, who desires for white skin and not only blue but bluest eyes as she is always considered ugly by her own Afro-American community of Lorain, Ohio of the 1940s which has internalized the misconception that black skin is unattractive. Also, she develops psychological crisis as she is rejected by her own people who mimic the European ideology. Chimamanda Ngozi Adichie in *Dear Ijeawele or a Feminist Manifesto in Fifteen Suggestions* (2017) provides fifteen suggestions to her childhood friend Ijeawele who seeks the advice of the writer regarding how to raise her baby girl Chizalum Adaora up a feminist. Nothing so far has been done to connect both these texts. Therefore, this paper attempts to study Toni Morrison's *The Bluest Eye* (1970) in the light of *Dear Ijeawele or a Feminist Manifesto in Fifteen Suggestions* (2017). It shows that the suggestions provided by Adichie are totally negated or not followed in the representation of the female characters in *The Bluest Eye*. The detrimental consequences which can occur if these suggestions are not taken into account is also examined. So, this paper delves into details into the analysis of *The Bluest Eye* in the light of *Dear Ijeawele*.

Keywords: Mimicry, Marginalized, Feminism, Subaltern, African-Americans.

Introduction

African- American people of Lorain Ohio in the 1940s has been the focal point of *The Bluest Eye* (1970) which is written by the American author Toni Morrison (18 February 1931- 2019). As her childhood friend seeks for blue eyes (Afterword, 1979, p. 168), the novelist attempts to portray a minor black girl as the protagonist of her novel. So, Morrison remains a spokesman of all the African- American children and she tries to subvert the idea that white is beautiful. *Dear Ijeawele or a Feminist Manifesto in Fifteen Suggestions* is written by Chimamanda Ngozi Adichie (15 September 1977-) in 2017. In this book she provides fifteen suggestions to her childhood friend Ijeawele who seeks the advice of the writer regarding how to raise her baby girl Chizalum Adaora up a feminist. As Adichie herself is also the mother of a delightful (p. 6) baby girl now, she writes an honest and practical letter (p. 6) to her friend. As per the author, women

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should be full person with identity who can read. Gender roles are nonsense and women must not think of marriage as an achievement. Questioning language which objectifies women must take place. Neither the oppressed should never be compared with saints nor females should make themselves too engaged with their appearance. Talking about romance as well as physical relationship to adolescent girls is also necessary for their security. Aside from these, wives along with husbands should work together to look after their babies. Women must be allowed to have their opinions so that they can be free to express themselves.

Analysis

According to Adichie, women must not identify themselves with motherhood only. Although becoming a mother is a glorious gift (p. 7), women should become a full person (p. 7) and they should never apologize if they are working because loving what she does is a great gift to give to the child (p. 7). In spite of the fact that women are supposed to stay at home as traditional mothers, the author advices that motherhood and work are not mutually exclusive (p. 8). Igbo women did farm as well as trade before colonialism and therefore, domestic work and care-giving should be gender-neutral (p. 8). Adichie suggests that fathers can take care of the child too. Neither wives should complain a lot about the imperfections of the husbands nor they should provide special gratitude or praise (p. 8) to the husband for caring the baby as he is only doing his duty. He is not helping or babysitting (p. 8) either. The responsibility of the child is on both the parents and so they should do it together (p. 8). However, Cholly, the father of Pecola never does any household chores nor he shows any interest in it. As he is neglected by his father Samson Fuller who criticizes Cholly's mother as "Tell that bitch she get her money" (p. 123) and his mother abandons him after four days of his birth, Cholly never gets the proper concept of a family. He develops aggression within himself, neglects his family, kills four white men and burns his own home abandoning his role of a father and husband. He rapes his teenage daughter Pecola as he has never understood the meaning of a family. Different from Frieda and Claudia's father who shoots at Mr. Henry who abuses Frieda, Cholly is himself the abuser of his daughter. Here Morrison points out that Pecola is not only the victim of racial shaming but also a crippled and crippling family (Afterword, 1979, p. 168).

Moreover, Adichie believes that the idea of gender roles is absolutely nonsense. Active trains, cars, helicopters and blue colour for boys versus passive dolls, cooking and pink colour for girls represents the distorted sexual roles. Mothers of baby girls are very restraining too. Hence, Chizalum should not only be taught self-reliance (p. 10) but also, she will be looked as an individual first so that she can reach her full potential (p. 10). However, in North of Lorain Ohio in the 1940s the birthday gifts of

all coloured girls are "big, blue-eyed Baby Doll" (p. 13). Picture books are filled with little girls sleeping with their dolls (p. 13). The colour of the dolls is pink, the hair is yellow which is in stark contrast with the black skinned, black hair and black-eyed African girls. Mahaffey (2004) correctly infers that the plastic, sawdust and metal used to create the white doll symbolize the artificiality found in the construction of not only racial but also gender and class identities (p. 164). Therefore, the process of objectification of the African girls begins at childhood because white skin of the non-Blacks represent beauty for the Blacks.

It can be noticed that Pecola craves for white skin and prays to God as "Please make me disappear" (p. 33). Her world is fragmented, disorganized as she suffers from lack of recognition in a loveless family whose name ironically is Breedlove. She is a subaltern marginalized voiceless girl. She gazes fondly at the cup containing the silhouette of white Shirley Temple's dimpled face and drinks "three quarts of milk" (p. 16) from it only to become white or "cu-ute" (p. 13). She thinks erroneously that if she has lactification and gets blue eyes she will be accepted within her family as well as the society. Frieda also adorns Shirley. In contrast to them, we can see Claudia who dislikes Shirley. She dismantles the dolls to find the beauty and the reason why people look at them and say "Awwwww" (p. 15) but not her. The split doll reflects the split psyches of the characters (Akhtar, 2014, p. 5). Pecola has no positive self-image as she internalizes the concept that black is ugly in her community which does not resist the wrong concept that white skin is beautiful. Inger- Anne Softing notes that Claudia is the only character in the novel who consciously makes an attempt at deconstructing the ideology of the dominant society (qtd. in Moses, 1999, p. 627). Still, it can be observed that she being a child is not at all engulfed still by the racial ideas of her society but she will obviously accept the norms later.

What is more, Adichie wants baby girls to love books of autobiographies, histories and novels (p. 1). In this manner, her language will make her understand and question the world, help her express herself, and help her in whatever she wants to become (p. 11). On the other hand, Pecola cannot lodge against the social segregation of her school. Pecola sits alone on a double desk in her class (p. 34) in her school. The teachers hardly glance at her and they call her only when everyone is required to respond. If any girl wants to be insulting to a boy, she associates the name of that boy with Pecola like "Bobby loves Pecola Breedlove" (p. 34). Even the boys harass her by saying "Black e mo" (p. 50). It is noticeable that these boys are themselves Black but they neither feel pity nor sad about the distress of Pecola. Bessie Jones rightly observes that Pecola is a composite of many fairy-tale heroines like Cinderella and she is an ugly duckling who does not change into a swan (qtd. in Bump, 2010, p. 155).

When Mr. Yacobowski the " fifty-two-year old white immigrant Shopkeeper" (p. 36) has total absence of human recognition (p. 36) as dark-skinned Pecola goes to his shop to buy Mary Jane candy, she stays passive. This adverse situation makes Pecola hate the dandelions as "weeds" though before this incident she considered them "pretty" (p. 35). Srima Nandi (2015) in "An Ecofeminist Reading of Toni Morison's *The Bluest Eye*'' comments that "clearing of the dandelions is another form of raping the earth" (p. 172). She compares the dandelions with Pecola and points out that just like Pecola is unwanted by the Whites as well as by her own community but is utilized for other jobs allotted for the Blacks as domestic servants, the heads of the dandelions are thrown away but the leaves are utilized for making soup and wine (p. 171). The "unyielding earth" (p. 4) where no marigolds bloom as per Ms. Sharifa Akter (2015) hints at:

> the outcome of prolonged oppression, the psychic barrenness of a community whose vitality and resourcefulness have been sapped by the constant pressure and stress of a hostile environment. (p. 35)

Moreover, Adichie claims that language should be questioned. Females can be called only mechanic, not a lady mechanic (p. 12). Women do not need to be championed and revered. They just need to be treated as equal human beings. Regarding marriage, Adichie mentions that marriage is definitely not an achievement (p. 13). Girls are conditioned from childhood to aspire for marriage while the boys are not. Taking the title of the husband occurs due to the overwhelming societal pressure (p. 13). The solution, according to the writer, is to take an absolutely new surname. As for the eight principle, it can be seen that women must be taught to reject likeability or the idea to please all. Being nice (p. 14) and thinking about the feelings of all those who are hurting them have made the easy prey of sexual predators (p. 14). Teach her to be kind, honest and truthful (p. 14). She can also like or dislike and be a subject (p. 14).

By contrast, Pecola has not been taught the language of resistance (qtd. in Mahaffey, 2004, p. 163). She does not question the idea that white is beautiful. Because dark skin is associated with poverty, low class and ugliness, African- Americans develop an aversion towards dark skin (Gabriel, 2007, p. 21). Even after its end African-American boys are full of adoration for Maureen Peal, a high-yellow dream child who is as rich as the richest of the White girls. Teachers respond to her "encouragingly" (p. 48). She can always get the company of all not only in the class but also in the cafeteria because she represents the White race, the superior race. This social acceptance of Maureen makes the MacTeer sisters jealous and they criticize Maureen as "six-finger-dog-tooth-meringue-pie" (p. 48). During their arguments with her, Maureen attacks their ugliness by saying "I am

cute! And you ugly! Black and ugly black e mos! I am cute!" (p. 56). Unfortunately, Pecola does not confront Maureen bravely but both the MacTeer sisters angrily fight against Maureen's insult.

Black skin colour women from Aiken, Marietta, Mobile and those places straighten their hairs. They are manipulated by the distorting elements of whiteness as they are detached from the realities of their historical and collective identity as an African (Gabriel, 2007, p. 87). Geraldine wants her son Junior to stay from dirty and loud niggers (p. 67). Because of this, Junior enjoys pushing black boys in the dirt and bullying girls. He kills the cat of his mother and puts all the blame on poor Pecola. Instead of listening to Pecola, Geraldine despises her straightway "You nasty little black bitch" (p. 72) because ugly Pecola is wearing "dirty torn dress" (p. 71). Pecola becomes a nonbeing as her sense of self is poignantly attacked by Geraldine. Surprisingly, Geraldine who keeps Bible and the picture of Jesus in her house feels no emotional connection with Pecola who belongs to her own race. Haakon Chevalier (1964) is right as he says that the North African-Americans are so detached from their roots that the cultural mummification leads to the mummification of individual thinking (p. 34).

Contrarily, it can be seen that the three whores, Marie, Poland and China who are "Sugar-coated whores" or "whores in whores' clothing" (p. 43) are free with Pecola as they are with each other. Although they like good Christian coloured women who tend to her family (p. 43), we can find that both Pauline and Geraldine who are like this have no love for Pecola.

As a result of her obsession and the traumas she has experienced, Pecola slips into a psychosis and she becomes totally self-consumed (Raj, 2016, p. 26). She suffers from split consciousness as she fetishes for bluest eyes which is an impossible obsession. Micah Elihue Whitcomb or Soaphead Church who abuses little girls uses her to kill the "old" (p. 136) dog Bob of the old woman Bertha Reese. Instead of advising Pecola about the impracticality of her wish, he lies that she will get blue eyes. It is notable that she is not at peace when she thinks that she has blue eyes. Her deluded imagination makes her want for "the bluest eyes in the whole world" (p. 161). Passive Pecola has absorbed all the ugliness of her community which is not at all proud of their race. In summer, the season of storm, Pecola has to endure the storm of rejection inside her psyche. Pecola's innocence is scarred by her own society whose members think that "she carry some of the blame" (p. 149) of her rape. Although Frieda and Claudia want Pecola's baby to live to counteract the universal love of White baby dolls, Shirley Temples, and Maureen Peals (p. 149), the baby dies. The baby's death symbolizes the ultimate loss of the future (qtd. in Mahaffey p. 156). No one wants to see her baby alive and no one says "Poor little girl" (p. 149) and "Poor baby" (p. 149) because she will give

birth to the "ugliest thing walking" (p. 149). Her own society degrade her skin color because they think of darkness as inferior.

As per Adichie, females must have a sense of identity (p. 15). Being an Igbo girl, Chizalum can embrace the beautiful parts of the Igbo culture and reject the rest. She should be given an Igbo name. To take pride in the history of Africans and in the black diasphora (p. 15) are also essential teachings for her. Noticeably, this influence of white skin has not ended after the demise of slavery. Pauline is never given any nick name. Pecola never gets any story telling or orature session with her mother. So, the novel serves as a warning to all African- American people that it is "too late" (p. 164) already and if they continue to do so, they will suffer from distorted life like Pecola. The novel's title manifests that the desire of Blacks for white skin and blue eyes is unachievable and so they must not run after it. The Afro- Americans will live a gibberish life if they emulate and internalize concept of white beauty. They must decolonize their mind from the belief that black is ugly.

In addition, in the words of Adichie, girls must be physically active (p. 15). They must be encouraged to participate in all kinds of sports. Plaiting skin must not be painful. Fashions and makeup depend on her choices. If she likes, she can be fashionable or makeup lover. She can avoid both as well. In mainstream magazines, film and television, whiteness is valuable. Nevertheless, Chizalum can be taught that non-slim, non-White women are also beautiful like slim, white women. Contrariwise, African women living in Africa and USA straighten their hairs, copy the Western style of English pronunciations and wear high heels in the novel. As Pauline moves from the South to the North, she also begins to care about clothes and makeup only to make other women cast favourable glances her way (p. 92). The movies use fair-skinned American actor and actresses like Clarke Gable and Jean Harlow. Pauline fixes her hair like Jean Harlow's magazine photo. She begins to condemn her own eleven-year-old daughter Pecola as "ugly" (p. 98). Unlike Frieda and Claudia's mother who rubs "Vicks salve" (p. 6) on the chest of her sick nine-year-old daughter Claudia and beats Henry when he sexually abuses ten-year-old daughter Frieda, Pauline beats Pecola as she knocks down the blackish blueberries. She calls Pecola "crazy fool" (p. 84) but she soothes white-skinned "the frozen doll baby" (p. 150) Fisher girl as she begins to cry by saying "Hush, baby, hush. Come Here" (p. 85). Ironically, this Fisher girl calls her "Polly" (p. 85) but her own children Sammy and Pecola call her "Mrs. Breedlove" (p. 32). By contrast, Mrs. MacTeer gives Pecola bath and washes her clothes as she is initiated into womanhood. Pauline does not address the two MacTeer sisters and Pecola by their names as they have no existence in her life. Contrarily, Pauline neglects her kitchen and her family but she does not leave the Kitchen until everything is in order in the Fisher house where she gets power, praise, luxury, beauty, cleanliness and

a nickname “Polly” (p. 99). Pauline who gets no nickname by her family due to her crippled foot fails to communicate with her two children. When she gives birth to Pecola and the doctor insults her that black women deliver right away without any pain just like horses (p. 97), Pauline is angry but when she begins to live in the North Ohio, she becomes a mimic character succumbing to the notions of the Whites. She does all these to be likable to her community and the Whites. In this way, she becomes an “ideal servant” (p. 99). Unlike the nice mother of Dick and Jane Primer who laughs (p. 1), we can see no emotional connection between Pecola and her mother.

Coupled with these, as for Adichie, parents must talk about sex with the little girl early. She remembers her old class three school days when while teaching about sexuality, teachers wrongly threaten them by saying that talking to boys will lead to disgrace and pregnancy. Female sexuality is not about shame (p.18) Period blood is not shit (p.18). Rather, it is sacred as it is required for reproduction. Sex is not only a marriage act (p. 18). In the novel Geraldine does not feel connected with sex in the novel. We can find that Claudia, Frieda, Maureen as well as Pecola do not have any proper knowledge about female bodies. Frieda does not understand what is happening with her as she is abused physically by Henry.

In teaching about oppression, oppressed are often compared with saints (p. 20) as stated by Adichie. It is assumed that women are morally better than men but to Adichie, female goodness is as normal as female evil (p. 20). It can be seen that Pecola’s mother Pauline thinks that she is an upright Christian woman who is send by God to ‘‘punish’’ (p. 31) her husband.

Lastly, all human beings are different. So, Chizalum will be full of opinions, and her opinions will come from an informed, humane and broad-minded place (p. 20). May she become what she wants to be is the last thought of Adichie. In contrast, the society of Pecola in the novel wants their girls to love dolls, to wear makeup and high heels and to have white skin and blue eyes. This leads to sheer debasement and identity crisis within the black-skinned African community of Lorain, Ohio in the 1990s.

Conclusion

All in all, the counselling of Adichie that women should become a full person with identities, opinions and they must question the gender roles and reject likeability is nullified in the novel. This negation can lead to severe ramification like madness as detected in the case of Pecola who wrongly thinks that she will be accepted in her society if she gets white skin and blue eyes. Here, Pecola loses her mental sphere as she is devoured by the meaningless notion of skin colour. As girls like Pecola

wants to be accepted by the white skin obsessed community, she fails to question the gender roles and the sexist language. Geraldine and Pauline neglect their own race as they become more attached to the West. In this manner, Morrison's character has nullified the advices of Adichie in *Dear Ijeawele* to a great extent and this has led to their sheer mistreatment in the novel.

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Use of Educational Technology in Bangladesh: Problems, Challenges and Prospects

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***Abstract*:** During this time learning through educational technology has been recognized worldwide because it ensures real quality education and the participation of the best number of students. Although the global demand for education technology is increasing day by day for the benefit of students and teachers, Bangladesh is in the very early stages of supporting such technology. To bring global standards in education, the government needs to realize the importance of e-learning as an effective medium of education and address all sorts of problems such as weak internet speeds, high data rates, rising prices of smart devices, lack of experts. The government should strictly enforce copyright laws to avoid infringing on software-based learning materials and to ensure reliable and authentic learning materials. However, the potential for the use of educational technology in Bangladesh also depends on the e-learning system, the skills of teachers and students, and the flexibility and updated technology. Although we have many shortcomings in this regard, teachers and students must ensure the highest level of interaction for the best benefit of e-learning using educational technology. The study mainly focuses on removing all barriers to the use of educational technology so that it can secure a stable platform in education.

***Keywords*:** E-learning, Educational Technology, Educational Technologist, Distance Education, Education in Emergency, Bangladesh.

Introduction

Education is the backbone of a nation and that is why the necessity of education has been accepted globally. A properly educated person with technical knowledge is a blessing for the country's economy. It is possible for him to alleviate poverty from the country. The right of education is a human right as well as a constitutional right of a citizen. The government is responsible for assurance of access to this right easily and feasibly so that the learner can utilize their potentials. From this trend, the teaching and learning process nowadays has become more innovative and modern. Institutions are looking for advanced and improved means of education so that qualitative education is maintained. Technology has a great impact on our day-to-day life and the use of technology in education is also growing

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because of its different advantages. Application of technology is also a strategic plan for reshaping tomorrow's world with skilled graduates. In the last decade, government of Bangladesh has declared Digital Bangladesh with an aspiration of adopting technological means in every affairs of life and with this passage education gets a touch of technology, though distance learning has an old practice in Bangladesh. The world is being more competitive day by day and the advancement in information and communications technology (ICT) brings a new set of challenges and pressures on countries of poor economy. As a whole, educational technology is still not being applied adequately in Bangladesh due to poor economy and also different shortages. Bangladesh, after realizing the circumstances seriously, should expand the accessibility to education with modern technology.

Conceptual Framework of the Study

E-learning

E-learning is the power of learning that is provided electronically through means such as live or pre-recorded lectures, videos, content, simulations, quizzes, games and other interactive elements. It is a technology-based learning strategy. An education system based on formal education but with the help of electronic medium is known as e-learning (What is 'E-learning, n.d). It can also be identified as a system-supported transfer of talent and knowledge delivering to a large number of recipients at the same or different time. It is also referred to as electronic learning or online learning or gaining knowledge through electronic system and media. Sarah Guri-Rosenbilt, faculty of the Israel Open University, distinguishes between distance learning and e-learning, saying that e-learning extends to face-to-face conferences with online meetings for online replacements from conventional classrooms as electronic media used for various educational purposes (Tamm, 2020). E-learning includes the following sections such as (i) Asynchronous e-learning for those who take the course on their own, usually on a laptop. It contains pre-recorded speech content and video, visual and other interactive elements; (ii) Synchronous e-learning refers to online learning, live-online training, synchronous online training, virtual classroom training, etc. Synchronous e-learning is set up in real time with geographical changes.

Educational Technology & Educational Technologist

Educational technology is a broad term that combines basic tools, methods and helpful assumptions for teaching and learning. Educational technology improves classroom learning through the use of mixed, face-to-face, or virtual learning. Educational technology is an internet-based stand for the digital features of study courses, typically within educational institutions

(What Does an Educational Technologist Do, n.d). Educational technology, in Bangladesh refers to the use of technology in education (Edtech in Bangladesh | All you need to know, 2023). It allows a computer-generated learning environment in education. It is a course system and provides resources, activities and interactions between different levels of assessment. It carries a certain level of assimilation with other organisms. Moreover, Educational technology is the joint use of computer devices, programs and educational concepts and learning facilitated training. The use of technology in education is based on academic knowledge of communication, education, psychology, sociology, etc. from various artificial intelligence based on computer programs. There are several areas where mobile technology is used, including learning theory, computer-based training, online learning and m-learning (Mohammadi et al., 2020). The use of technology primarily allows the following to ensure a virtual learning environment or online learning curriculum, namely (i) content creation, storage, access to and use of e-resource learning materials; (ii) curriculum planning, lesson planning, evaluation and personalization of learning experience; (iii) managing of access to new materials and resources and recruits and manages students following progress and achievement; (iv) Collaboration and actual communication such as blogs, chats, emails, wikis, notices, live and recorded audiovisual conferencing etc. This is a comparatively new skilled area but is in demand at most universities and colleges as new technologies continue to develop, faculty and instructors begin to move toward online learning, and move toward more blended learning(Bates, 2019).

Besides, an educational technologist is an e-Learning expert who works in providing support and aid with the progress, execution and scrutiny of latest technologies that develop the learning process (What Does an Educational Technologist Do?, n.d.). An educational technology specialist is accountable for serving schools and makes educative decisions about the using of new strategy and online possessions that is incorporated into classrooms (How to Become an Educational Technology Specialist, n.d.). Educational technologist is also identified as an instructional technology specialist. Educational technologist connects Education and Technology to resolve habitual face-to-face schooling troubles and make easy the enrichment of the learning experience.

Literature Review

Guterres, et al. (2017) point out that although more has been spent on the introduction of virtual education, recent technological innovations, including the rapid adoption of smartphones in society, have made it easier for anyone to access virtual reality. They further noted that educational institutions would benefit from better access to virtual libraries by breaking the boundaries of formal education.

Islam (2016) focuses on learning through simple and attractive methods for the enjoyment and independence of students and acknowledges the role of educational technology in teaching for ultimate achievement. He focuses on educating both students and teachers about the use of Internet-based information and communication technology in teaching and learning. He demanded an important role of the government in this regard.

Khan, et al. (2021) has found digital education as a prevalent mechanism of learning. They have mentioned that unprivileged students can get education due to its low cost. They have focused and demand a central digital education system which is so comprehensive and cost efficient. The use of educational technology is able to reduce the eliminated and lost students due to unforeseeable reasons.

Basilaia, G. et al. (2020)focused on the need for educational technology in the learning process, especially during epidemic times like COVID-19. Despite many limitations and challenges they offered online interactive learning using tools like Gmail, Calendar, Classroom, Jam Board, Forms, Drive, Hangout, Meet, Drawing etc. which are part of G Suite for education. Due to the importance of educational technology during the recent coronavirus pandemic, they highly recommended a rapid transition in traditional form of education to low-cost online education.

Sivalingam, D. & Subbaiyan, M. (2018) focused on youth easy access to modern technology like access to Internet, computers, cell phones, smart phone and many more those also have effects on educational performance. They have also observed the correlation between young usage of computers and educational performance and found out that modern technology influences learning both positively and negatively. Finally, they have suggested parents, the media, educationists, and policy makers among others to raise the benefits and cut the harm of technology for youths.

Raja, R. & Nagasubramani, P. C. (2018) in their study have identified technology as a gift of God and showed important role of technology in every sphere of life in respect of many complex and critical processes and modern technology brings ease and greater efficiency. They demanded that technology has revolutionized the field of education and made the process of teaching and learning more enjoyable that's why importance of technology in schools cannot be ignored.

Objectives of the Study

The objective of the study is to analyze the importance of technology in education. The other objectives of the study are to show present statement of using technology in education of Bangladesh. The main objective of the study is to find out prospects and challenges of using technology in education of Bangladesh.

Limitations of the Study

As there has not been accompanied sufficient research on the problem till now, there are no satisfactory materials which the author could have gone through and use a supportive materials. However, a very few number of articles relevant to the topic are available on internet but the author could not get them free of cost and the author could not address all points of the study strongly.

Methodology

The study is obviously an exploratory one and is founded on review of previous relevant research. The findings of various previous studies have made important contributions to the needs and possibilities of the research topic. Research methods include text analysis, content analysis and document analysis. Founded on interpretive approaches, textual analysis is a sort of qualitative study that centers on the new ideological and cultural assumptions of wording (Arya, 2020). A systematic review is a kind of assessment that uses repeatable methods to discover, choose, and combine all available evidence (Turney, 2022). Content analysis is a qualitative research means or system widely used to examine content and its features. It is an advance used to enumerate qualitative information by cataloging data and comparing different pieces of information to sum up it into useful information (What is Content Analysis?, n.d). Document analysis is important because it permits researchers to make sense of their resources and select the right pieces for their studies Document analysis is significant because it permits researchers to make sense of their resources and select the right pieces for their studies (Bowen, 2009). This study was based on secondary data only. Secondary data was collected from various national and international periodicals, books, newspapers, magazines and websites. Data were evaluated using a theoretical framework and various literature reviews on the topic. To conduct the research, the researcher used systematic research methods to identify some related edited and unedited direct works and various published and unpublished papers. The collected data have been processed and prepared in the present form in order to make the study more educational, analytical and convenient for the readers. The process of qualitative data analysis has been emphasized because it is descriptive and analytical in nature.

Importance of Educational Technology

The use of technology has become an essential part of our lives in contemporary society. The development of technology has connected every part of our lives in a way that communicates with each other and that is why reliance on technology in education is now an inevitable issue. It has transformed the general education system and the way of learning into an

online platform (learning online or just showing a video in a classroom). Students use technology in education to gain easy access to the vast resources available to them and are encouraged to do research and thus become more independent in learning. Sometimes a general education system or classroom education confuses a student with a traditional lecture in the classroom while a conceptual audiovisual system makes the concept of learning more enjoyable. Also, some people do not have access to classrooms or full-time employers gain access to online courses and qualify by paying less which they have not been able to achieve intelligently. The use of technology in education makes it easier for both students and teachers by reducing the time and cost of teaching (Importance of Technology in Education, n.d.). And that is why many educational institutions that recognize technology in education have already made progress in using technology as a method of education. However, some of the importance and benefits of technology in education are highlighted below:

- The use of technology is being widely evaluated by experts from all angles of field and industry. Its integration with learning makes students more interactive, skills and technology understandable and students will achieve the learning goal.
- New learning concepts using smart tools can boost students' confidence, empowerment and ability to learn new material.
- Options such as online degrees and eliminating the need to purchase physical textbooks have significantly reduced the cost of education. By accessing academic articles from the institution's database, teachers and students can easily choose to continue the teaching and learning process wherever they reside (How Technology is Already Breaking Down Barriers in Education, n.d).
- Technology has reduced barriers and made education resources more accessible.
- Since modern technology behaves like artificial intelligence, teachers can create more practical and innovative lesson plans for students.
- Education technology has removed educational boundaries through distance learning, online education and access to up-to-date information in the universe (The growing importance of technology in education, n.d.).
- It offers courses ranging from philosophy to fashion design, from religion to commerce, from photography to yoga, from programming to painting.
- It helps students around the world collect and share information and ideas.
- Since the materials available online can be evaluated and reviewed at any time, it helps to maintain the quality of education.

History of the use of Technology in Education

The concept of online education is not new but has been developed very recently using modern technology in education. Great Britain has an ancient practice of online learning for over 170 years where instructors send lessons and receive student assignments by mail (Tom, 2017). In 1950, for the first time in the history of the world, classes were conducted using slide projectors and televisions. The University of Illinois, USA first introduced online education in 1960 by creating an interlinked network using computer terminals. The University of Toronto launched a full-fledged online course in 1984, and two years later the electronic university network DOS and Commodore 64 were recognized for use on computers (Sarkar, 2020). It was the University of Phoenix, the world's first educational institution that launched a full-fledged online collegiate institution in 1989, offering undergraduate and graduate programs. Britain's Open University introduced online distance learning in the early 1990' as one of the first universities in the world. Currently, Indira Gandhi National Open University, the largest university in India, is currently offering online education. Basically, the spread of online learning or technology-based learning is increasing at the present time with the wide accessibility of smart devices like internet, new 4G, 5G network technologies and enabled smart devices. Indeed, the twenty-first century has revolutionized the world of education. The use of technology in learning is no longer limited to higher education. The recent Covid-19 epidemic underscores the importance of technology in learning in today's education system. Moreover, in recent times, the use of technology in acquiring knowledge is growing faster than the old-fashioned fields.

Present Scenario of Educational Technology in Bangladesh

Vision 2021 sets an aim to make Digital Bangladesh. It is one of the country's main dreams and that is why an extraordinary importance is specified on the application of digital technologies (Rahman, 2015). Bangladesh government has initiated mass number of schemes like Information and Communication Technology (ICT) Policy-2009 connecting to digital technologies to attain middle-income status of the nation by 2021 and developed status by 2041. In the digital era teaching and learning methods are using different digital tools substitute to antiquated classroom education. As a result over the last few years the education system and curriculum of education has been changed in Bangladesh. The accessibility and technological knowledge has made the educational technology increasing rapidly. The Bangladesh Telecommunication and Regulatory Commission's (BTRC) has revealed that currently 110.90 million people and 10.05 million people use mobile internet and broadband internet respectively (Bangladesh's mobile internet users increased by 3.4m in June, August 05, 2021). ICT has directed and accelerated field of education in Bangladesh that helps teaching and learning of education and research based works. Currently, it cannot be denied that sources of educational materials developed and experienced through

automatic medium. Today most of the educational institution for ensuring modern learning theory (an educational idyllic having focus on principle) leads the use of technological means for making learners ready to cope up with global challenges. Students and teachers are now a days using classroom based technology like Google Meet, Zoom, Messenger and Skype. Besides, some professors and researchers are found very intense in by means of educational technology (the use of quantitative and qualitative software's like statistical package for social Sciences) for scrutinizing problems on research based works (Islam, 2016). The use of technology in educational field had begun in early 1956 in Bangladesh. The Directorate of Education was allocated with the accountability for spreading of 200 radio receivers to educational organizations and in 1962, an Audio-Visual Cell later on Audio-Visual Education Centre was established in consequence. To encounter the global experiment, Bangladesh after independence established National Institute of Educational Media and Technology (NIEMT) in 1983 that got transformation in the Bangladesh Institute of Distance Education (BIDE in 1985 and finally the Bangladesh Open University (BOU) Act, 1992 had been passed. Bangladesh Open University is the pioneer to use technology in education. In addition to audio-visual educational materials BOU offers different Bachelor program in distance mode through television (Bangladesh Open University, n.d.). 10 Minute School is a nice application and initiative to accelerate education through technology like YouTube. Since mid-2014 the 10 Minute School operated and conducted online video lectures for students university admission tests, GRE, IELTS and different program based on individual skill progress. Interactive Cares, Bohubrihi, Thrive EdTech, Shikho, Upskill are mentionable platforms that use technology for teaching and learning processes (EdTech Industry Overview: Bangladeshi EdTech Startups, 2021). Digital education or using technology in education is an education procedure in where the students customize their digital devices like computers and smartphones over the internet. Though digital teaching-learning mechanism had been used earlier in Bangladesh but it has become a need in recent time. This time digital teaching learning system gets significance to lessen the actual gap of education sustained by the students due to rising of the coronavirus epidemic. Different private universities for the first time had initiated online classes using technology from April 2020. Afterward many public universities and other educational institutions of different levels also began the same practice. There are financial reasons along with altruistic reasons for guaranteeing the steadiness of education through technology. Besides these trends, telemedicine education and different citizens need gets technological feedback in recent time. Now Bangladesh is ready to recognize digital education at full phase.

Problems and Challenges for Educational Technology in Bangladesh

The use of technologies in education has brought a revolution in the world. Easy accessibility of digital device and digital networking system has

created a new picture of education system in Bangladesh. Though newer learners have constantly lived enclosed with digital technologies, it does not denote the proficiency of learners using digital mechanism in learning (Prensky, 2001).

Technologies in education require particular developed infrastructure and readiness of the stake holders to attain all-out learning welfares. Bangladesh had experienced distance learning through television or radio, e-mail etc. but full phase digital learning during ongoing Covid-19 period was new. Country has faced different challenges of digital education. The government closed all learning institutions through a nationwide lockdown on 26th March, 2020. Later on, government ordered and arranged distance learning by name of online education with pre-recorded materials and student's homework based digital session run by state own television. A study of BRAC shows that since 50% of families of Bangladesh do not afford a television it is a very non-effective and non-interactive method of education. The study shows also that around 49% families have no access to a computer and 54% to internet while 59% have no access to smartphone that is essential for digital learning (Anik, 2021). The study also reveals that online classes during this pandemic situation provided benefits for 4% students with disabilities, 8% students from ethnic minorities, 87% bangla medium students, 13% madrasa students: 73% students living in rural areas compared to 27% urban areas. Another survey conducted by the World Bank in July, 2020 revealed that 86% and 74% of learners and parents respectively were aware about educational programs of Sangsad Television, a state owned TV while 92% has the access to television and 43% accessed to television after being shared (TV-Based Learning in Bangladesh: Is it Reaching Students?, 2020). The students' consciousness and entry to digital education through digital platforms is alarmingly low with a comparison of distance learning. Later on, the Government gave focus on student's accessibility in online through YouTube platform and it demands free access to broadband services. Only 50% students are alert for digital education among only 21% have internet access while 34.8% have access to a smart phone and 3% have computer access. There is also discrimination regarding access to internet. 25% of male students have internet access compared to 19% of female (ibid). The use of technology in education of Bangladesh is facing different problems and challenges. Some problems and challenges are sorted out in the following:

1. Most of the educational institutions of the country severely face the infrastructural shortages. The teachers and other staffs are not trained with sufficient practical knowledge of information and technology so that they can tackle any unforeseeable need. The institutions lack in computers and frequent internet accessibility.
2. The Prothom Alo (English online) had noted on 24 April, 2018 that Bangladesh has the lowest mobile internet speed among the South

Asian countries. Besides all mobile operators has no full coverage and stable network. Using mobile data renders huge cost corresponds to their service. Picture of broadband is also worsening. It is a great challenge for digital learning process. This situation leads to students' want of attentiveness in academic session.

3. Sometimes the students do not get free access to e-material and if they avail access but do not get authentic information rather harmful content. The condition of student's language skill is also miserable. Copyright protection and such online threat are highly challenging matters.
4. Education through digital platform requires strong interaction between teachers and students. Practical experience of digital education in Bangladesh reveals that there is no mentionable interaction and proper planning. Moreover, the contacts they build are appeared to uncooperative.
5. There is a gender gap relating to financial status particularly in countryside. Normally, male gets easy access and possession of smart device but it not possible for female learners. Possessing a smart device by a female brings bad social impression. So, social attitude is a challenge for education through technology.
6. It is a great challenge of digital education to ensure stable power. Though 90% population of the country gets access to electricity, in rural actual picture is worsening. Rural student bears unbearable load shedding and they cannot participate in virtual classes and its difficult for them to stay connected.
7. Virtual class on smart device needs to pay a high price and price of the device are not within affordability of the users. This situation leads to additional financial burden for a student as well as for his family.
8. Digital learning requires sophisticated learning in a calm and quit environment. But picture shows that it is hardly possible to ensure that environment. Parents cannot afford a separate room for his children for live class. Besides, they have a negative approach to the virtual classes.
9. For development of a student, social interaction is urgent. Some of our students become isolated in society due to extra addiction and unfair use of internet.

Prospects of Educational Technology in Bangladesh

The prospect of education using digital platform is immense. It brings advantages for not only teachers but also the learners. Today the students found so much enthusiasm in self-learning and digital learning process. It

is nicely suited to them. Educational technology breaks the limitation and creates opportunity so that the learners are able to make rational and geometric approaches to attain certain academic objectives. Digital learning does not require extra preparation and skills to participate a class in any situation from any place. Students of the country are already accustomed to the recent trends of education due to the prevailing global epidemic, Covid-19. When the learners were in uncertainty of education, Covid-19 brought an opportunity to the education sector and enabled our learners to achieve more and diversified knowledge. Country's development depends on the technological development and its expansion. The educational technology-based market in Bangladesh is growing rapidly with new stakeholders and crating influences on entering the market. The education sector is now the most important sector in the country and that is why the government is investing heavily in it in recent years. Consequently, there is a huge demand for educational technologies in the country. Tech in Asia has mentioned in a report regarding the prospects of educational technology in Bangladesh that the market is expected to cross $ 700 million by 2025. One of the leading educational technology based institutes 10 Minute School in Bangladesh has drawn global attention and got US$2 million fund granted by, the accelerator program of VC firm Sequoia India (Bhusan, 2022). The more digital the country becomes, the more we get citizens with technological knowledge and skill. It is desired for a constant platform of digital learning process that contributes much to the country's economy.

Findings and Recommendations

Bangladesh is rapidly being accustomed to technology in educational and getting attractiveness to a better slot in education and students' understanding of learning. With the widespread access and use of modern technology and internet opportunity in the country, different education providing institutions are developing technology based products and services to meet with the current needs of students and educators. From online education platforms and mobile apps to virtual and augmented reality, educational technology is changing the way of delivering education in Bangladesh and has the potential to renovate the education method. This study also reveals that the government considers vocational education, information and communication technology (ICT) based education as a priority area for development of secondary level to the higher secondary level to provide a foundation of basic skills and knowledge in technology **(**Haider, 2022). In this article, there is a deep exploration of the trends and innovations shaping of educational technology and developed industry in Bangladesh, as well as the challenges and prospects in this field.

Here are some observations and recommendations to meet up challenges of education through technology and may be highly taken into consideration:

1. Online learning processes should be strengthened by trouble-free and flexible operations of educational digital tools. Mobile applications and other digital platforms should have flexible recording options available so that the learners can record a live session and can use it on later. Internet coverage with uninterrupted power is desirable and data charge should be revised for better access to digital platform.
2. Discrimination in learning process among male, female, disabled, ethnical minorities, urban and rural learners should be removed. Equal and effective means of education should be ensured.
3. There should be a strong interaction between persons in teaching and learning. Guardian's supervision should be closely maintained.
4. Authentic information and educational materials, taking into account each student's socioeconomic and socio-cultural conditions should be stored on digital platform. Educational programs and materials should be enjoyable so that students can go through it easily like easy assessment and short curricular. Modern language courses should be introduced so that the students can understand the educational materials. Copyright protection should be maintained.
5. Education through digital tools incurs cost for both of the persons in teaching and learning process and sometime requires training. The teachers and students cannot afford the cost some times so, there should be separate allocations of money and other institutional arrangement so that they have unlimited access to internet.
6. Institutional positive activism is very urgent. The government, educational organizations, private or public and other relevant institute must support and ensure the process so that the students feel enthusiastic and get quality education.
7. Lastly, public awareness should be increased by letting them know of the advantages of digital education, social negative approach should be removed.

Conclusion

Technology in education is a demand worldwide. To maintain international standard in education there is no exemption in this regard. However, the trend using technology in different sectors especially in education is just a requirement of Vision 2021 of the government of Bangladesh. Encouraging the practice of digital revolution in education is possible by letting graduates access the well-being of their upcoming days and influencing their focus properly. Every academic institute in the country can monitor digital learning stands and permit skilled teachers to grasp beyond the classroom by training them with their acquaintance. Flexibility of new ideas for

updated knowledge can start with a short course online and response can be observed. Technology in the classroom has many benefits, from stimulating a sense of individuality and enablement to allowing socialization and creativeness, not to mention problem solving and perseverance. There are lots of technological changes in education segment over the past decades as new systems, platforms and applications have allowed new pedagogies and new ways of approaching the learning processes (Rahman, 2019). Though the trend is very recent, Bangladesh has already brought different success in using technology in everyday life. Shikho, Upskill, Education Ninja, Eshkul, Repto, Educarnival are different digital platforms using digital tools like YouTube, Zoom, Facebook, Blog and so on to teach learning process (Rabab, 2021). Technology has prospects for young men of the country and can bring a striking opportunity of them in employment issue. Tomorrow's world is becoming fully digital and virtual, and only those countries may sustain in the long run those are proficient in technology. Teachers and students must realize that learning by using technology overall brings relief. Bangladesh is to challenge different shortcomings of pure digitalization. Hence, teachers and students should adopt the means of digital tools in education effectively and academic institution should formulate well-planned strategies to attain and avail the betterment of technology in educational fields.

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A Critical Study on the Narrative Techniques Adopted in Virginia Woolf's *To the Lighthouse*

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***Abstract*:** Virginia Woolf, a Victorian novelist, critic, and prose writer, is widely considered one of the most renowned authors of the twentieth century for her non-linear storytelling and unique exploration of contemporary issues. Woolf is often regarded as the most psychological of the modernists because many of her novels focus on the literary method known as stream-of-consciousness, which aims to recreate the thoughts that shape the character's mind. Her masterpiece, *To the Lighthouse*, is a superb example of her literary philosophy and experimental approaches that include the unconventional use of the narrative technique of stream of consciousness along with free association and indirect interior monologue. This study closely examines the brilliant fusion of these techniques in the novel *To the Lighthouse*. Sigmund Freud is the pioneer of the concept of free association. He has an immense impact on the writing of Virginia Woolf. His influence can be traced in the writings of the novels of Woolf like *To The Lighthouse* and *Mrs. Dalloway*, inscribed breaking the traditional structure. Not only stream of consciousness but also another narrative style, the use of parenthesis is thoroughly looked into in this study concerning *the Lighthouse*.

***Keywords*:** Free Association, Interior Monologue, Modernism, Parenthesis, Stream-of-consciousness Technique.

Introduction

Pragmatic human thoughts are depicted by a method known as Stream of consciousness in the realm of literature. It helps to portray the disorganized logic of the human mind breaking from all the conventional rules. Virginia Woolf's *To the Lighthouse* is one of the fine examples where this technique is brilliantly used. This method is quite similar to the theory of free association which is frequently followed in psychology. Generally, "Free association — a tool used in psychoanalysis — aims to deepen your self-understanding by looking at whatever thoughts, words, or images come freely to your mind." ((*Free Association Therapy: Definition, Uses,*

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Process, and Effectiveness, n.d.) Free association is followed in this novel. Another essential device known as interior monologue is also adopted in this novel. In different ways, the practice of stream of consciousness/ free association and interior monologue is observed in the novels by Woolf.

Theoretical Framework

This study aims to thoroughly examine the narrative tactics utilized by Virginia Woolf in her influential novel *To the Lighthouse*. This inquiry is based on the theoretical framework of modernist literary theory. It aims to clarify the complexities of Woolf's narrative experimentation and how it affects literary discourse. It will use ideas from well-known literary critics and scholars.

Our investigation analyzes Woolf's narrative strategies about modernist aesthetics, which developed as a response to the fragmentation and dislocation caused by the onset of modernity (Bradshaw, 2016). Modernist literature, known for its deviation from conventional narrative forms, represents a deliberate attempt by authors to depict the intricacies of human thought processes and the fragmented aspect of existence (Brooker, 2010). Woolf intentionally avoids using a linear, plot-focused storytelling approach in *The Lighthouse* and instead opts for subjective, introspective methods of narration. Woolf's study is primarily focused on her skillful use of stream-of-consciousness and interior monologue techniques. These approaches provide readers with exceptional insight into the inner thoughts and emotions of the characters (Goldman, 2018). Woolf creates a narrative landscape that is personal and subjective by avoiding traditional omniscient narration. This mirrors the ever-changing and fluidnature of consciousness.

Moreover, Woolf utilizes polyphony and narrative plurality in "To the Lighthouse" to enhance the complexity of the text, including various perspectives and voices to mirror the diverse aspects of human experience (Moi, 2006). The polyphonic form of this work highlights the subjective nature of truth and reality. It also encourages readers to actively participate in the process of creating meaning as they encounter the various perspectives offered in the text. Woolf's narrative approach is enhanced by her skillful utilization of symbolism, imagery, and intertextuality, which infuse the text with several levels of significance and profundity (Bowlby, 2012). The use of symbolic motifs and emotive imagery enhances the depth of interpretation in the text. Additionally, intertextual references and literary allusions provide connections with wider cultural, historical, and literary contexts, thus enhancing the overall reading experience (Marcus, 2018).

Woolf's deliberate use of temporal discontinuity and narrative fragmentation challenges traditional ideas about time and narrative structure. This encourages readers to rethink their understanding of time and

historical discourse (Hussey, 2011). Woolf disrupts the straight flow of time by using non-linear narrative structures and elliptical storytelling techniques. This reflects the unpredictable and uncertain quality of human experience.

This study aims to clarify the importance of Woolf's narrative experimentation in *the Lighthouse* within the context of modernist literature. It utilizes contemporary literary criticism to offer a detailed analysis of her narrative techniques and their wider implications for literary discourse.

Literature Review

The stream-of-consciousness technique was highly used in the literary writings of Victorian authors. The free association theory of psychology is closely associated with this technique. The development of a style in modernist literature could be characterized by a focus on formal fragmentation, numerous viewpoints, and alternatives to conventional narrative formats. Compared to their predecessors, modernist writers were more conscious of the objectivity of the environment. Thus, the division of social norms and cultural guarantees, the shifting of its meaning and sense from the usual context, the appreciation of the desperate individual faced with an uncontrollable future, the frustration, the stream of consciousness, and the free indirect speech are some of the themes that characterize modern literature. With a focus on more significant elements like historical and societal developments, this literary approach frequently goes beyond the bounds of the realistic novel. A writing technique known as “stream of consciousness” aims to capture the organic flow of a character’s extended thought process. This is frequently done by incorporating sensory details, unfinished thoughts, unconventional syntax, and sloppy grammar. Readers can “listen in” on a character’s thoughts when writing in the stream-of-consciousness style. The method frequently entails using language in unusual ways to mimic the intricate paths that thoughts follow as they develop and circulate within the mind. Stream-of-consciousness writing can be done in the first person or the third. (LitChart nd) Although it is an internal monologue, it goes beyond that. Free association, looping repeats, sensory observations, odd (or even nonexistent) punctuation, and strange syntax are all features of stream-of-consciousness storytelling that help us better grasp a character’s psychological condition and worldview. By employing this method, authors hope to capture the emotional and psychological reality of the brain’s actual movement from one place to another (What Is Stream of Consciousness? | Definition & Examples, 2023).

The interior monologue and free indirect speech are two technical devices used by the new literary form known as “stream of consciousness” to represent ideas. The reader is shown a character’s ideas in both interior

monologue and stream of consciousness. There are distinctions between the two, though. The character's ideas are frequently expressed in interior monologue utilizing traditional language and syntax, as opposed to a stream of consciousness, and typically follow a clear logical development from one line to the next. A character's thoughts are expressed through an interior monologue in the form of whole, logical phrases as if the characters were speaking to themselves. In contrast, the stream of consciousness aims to capture the turmoil and distraction of thinking as it occurs. The goal of "stream of consciousness" writing is to make the readers feel a character's ideas in the same way that the character is thinking them. Free writing and stream of consciousness seem to be the same. The stream of consciousness, however, is a literary method in which the character is first planned (*Stream of Consciousness - Definition and Examples LitCharts*, n.d.) and then sketched before thoughts are added. Free writing is specific, planned, and subject-focused. Both nonfiction and fiction are involved in it. The stream-of-consciousness technique, on the other hand, is character- and goal-specific in literary writing. Nevertheless, there is a similarity between the two in that they both require a clear mind to write about a subject, which in the case of fiction may be a character and in the case of free writing could be a non-fictional essay (Rowland, 2022).

Stream of consciousness was first used in modernist literature in the late 19th and early 20th centuries. Many of the authors who invented stream-of-consciousness literature did so to improve how the human experience was depicted in literature, particularly in the modern, urban, and industrialized world.(*Stream of Consciousness - Definition and Examples | LitCharts*, n.d.) Virginia Woolf, a modernist author, was a stylistic pioneer in the use of the stream-of-consciousness approach. In a stream-of-consciousness style, her masterwork *To the Lighthouse* dives into the thoughts of its protagonists. The ideas and feelings of the characters melt together, and their outer acts and dialogue are overshadowed by their inner thoughts and ruminations (Rowland, 2022).

One of the great literary innovators of the 20th century who tried this technique was James Joyce. Many modernist and post-modernist writers were affected by his experimentation with interior monologue techniques. Joyce employed stream of consciousness in *A Portrait of the Artist as a Young Man* to offer the reader constant access to the protagonist's mind, feelings, hatred, and consciousness. In her novel *Beloved*, Tony Morrison employs the stream-of-consciousness approach. Stream-of-consciousness writing techniques are used by modernist poet T.S. Eliot in his well-known poem, "The Love Song of J. Alfred Prufrock." Although Eliot uses associative thought to transition from idea to idea and sentence to sentence, the poem mainly adheres to conventional grammar and syntax. William Faulkner is renowned for using a stream of consciousness, just like Virginia Woolf. In conclusion, several critics have strongly criticized the novel's use

of the stream-of-consciousness approach. Wells despises this book for its "copious flatness." Herbert Read dislikes its "awful fluidity" and the way that form and structure break down in works by Joyce and Proust. As a result, the novels where this technique was used, frequently became illogical and formless, which made it intolerable for the majority of readers. However, Virginia Woolf deserves credit for giving the chaotic novel of this genre form and discipline and making it acceptable to the average reader. Her contribution to this field is of profound significance. Of course, Bergson and Joyce have had a big impact. She does not, however, follow in the blind footsteps of the great masters of the novel's stream-of-consciousness style or the psychologists who provided its theoretical underpinnings. Her approach is wholly original. Virginia Woolf was a brilliant experimentalist. She tried a variety of techniques and gave the stream-of-consciousness technique several tries and turns before eventually finding total success in *Mrs. Dalloway* and *To the Lighthouse* (Ash, 2021).

Discussion

Virginia Woolf has irretrievably transformed the course of fiction. Her strong and sometimes troublesome career has generated her in-depth awareness and understanding of the importance of new concepts and techniques in fiction, which has had an enduring and far-reaching impact. She reframed and changed the ideas of plot, character, diction, and structure in a new perspective. According to Woolf, identity was in a constant state of formation and could not be achieved through external observations. A novelist's job, according to Virginia Woolf, is to capture "the atoms as they fall upon the mind" (*Modernism*, n.d, p. 889) to convey the essence of awareness. Her interest in the inner activities of the mind and her conviction that the written word is a mirror of reality have made her fiction susceptible to a wide range of philosophical readings. She has a unique ability to delve deep into her characters' thoughts and uncover their hidden motivations and desires that cannot be found in the works of her contemporaries. She moves from a realistic novel's impartial and exterior universe to psychic novels, perhaps because she recognizes herself as "a porous vessel afloat on sensation; a sensitive plate exposed to invisible rays" (Woolf, 1998, p. 133). Meg Jensen claims that Virginia Woolf established the connection between interior and exterior, public and private observations and identities (2007, p. 115). Woolf uses the inner conflicts of the characters to create a further faithful depiction not only in them but also in the other characters with whom they interact. She has focused on using the identical method in the novel where the characters are revealed through the inner consciousness.

She has rooted for the method so badly that she criticized other writers for sticking to the conventional techniques. After mentioning "modern fiction," the author Woolf censures H.G. Wells, Arnold Bennett, and John Galsworthy for their characters' lack of spirit due to their preoccupation

with the body. According to her, the writers mentioned above are so preoccupied with the external acts of their characters that they fail to recognize that they have no life. Mikhail Bakhtin states that what is crucial to Dostoevsky is not how his hero seems to the outside world, but rather, how the hero appears to himself. (Bakhtin, 1984, p. 47) This comment is very near to the viewpoint of Virginia Woolf regarding the interior reflection of characters rather than their external reflection, which she would consider a soulless picture of the events that affect them. According to this perspective, characters are active and determining agents in fiction and no longer serve as passive mouthpieces for the author. She has a talent for creating characters with changing and transient identities based on relationships with multiple dimensions. In experiencing life's moments, Woolf believes in a fleeting, unpredictable, and changing world in which interconnected relationships are more influential than self-centered identities. She says, "Examine an ordinary mind on an ordinary day." and again:

> Life is … a luminous halo, a semi-transparent envelope surrounding us from the beginning of consciousness to the end. Is it not the task of the novelists to convey this varying, this unknown and uncircumscribed spirit …..?" (Humphrey, 2022, p. 13)

In literary analysis, the "Stream-of-Consciousness" theory refers to a descriptive mode or technique that aims to show the author's numerous thoughts and emotions. Alexander Bain originated the term stream-of-consciousness in the first volume of "The Senses and the Intellect" in 1855. *Pointed Roofs* (1915), the first of Richardson's pilgrimage books, is recognized as the first English stream-of-consciousness novel. Richardson states that Proust, James Joyce, and Virginia Woolf, all employed the new technique at the same time, but in vastly different ways. At first look, it appears that the theory of stream-of-consciousness, with its psychological underpinnings, is fundamentally solipsistic and individualistic. However, a closer look reveals the inter-subjective nature of stream-of-consciousness and the dialogical essence of the fluent and interdependent cognitive process. In his examination of the interactive essence of the mind, Cui cites Fernyhough's claim: Adopting L.S. Vygotsky's idea - our higher mental functioning emerges from social interactions, he contends that thinking is fundamentally social and dialogical. And it is precise because our minds are social that certain forms of internal thinking are even feasible in the first place (2016, p. 217). According to this theory, the mind's interactive aspect makes its entire process and function comprehensible. The author creates a story that seamlessly transitions from the portrayal of one character's thought to that of another without any limits by using Bennett's point of view and the Stream of consciousness technique (1964, p. 103). As a result, the interwoven emotions and actions of the characters- who all influence one another's experiences and are seen from different perspectives- form the narrative.

The fact that each character has several consciousnesses within his or her psyche, in addition to the various consciousnesses present in dialogic modernist literature, is a crucial aspect that should be taken into account. In *To the Lighthouse*, one of the key traits is the existence of multiple consciousnesses within a single individual:

> […] but for all that she thought, watching it with fascination, hypnotized, as if it were stroking with its silver fingers some sealed vessel in her brain whose bursting would flood her with delight, she had known happiness, exquisite happiness, intense happiness, and it silvered the rough waves a little more brightly, as daylight faded, and the blue went out of the sea and it rolled in waves of pure lemon which curved and swelled and broke upon the beach and the ecstasy burst in her eyes and waves of pure delight raced over the floor of her mind and she felt, It is enough! It is enough! " (Woolf, pp. 71-72)

This segment illustrates the internal polarization in Mrs. Ramsay's mind with the help of an inner monologue during an epiphany. By bringing about the erratic contemplation of things and their interrelations in the wandering minds of characters, the author is, in fact, able to disrupt the atmosphere of the narrative's inexorable laxity, stagnation, and boring repetitions. The author replicates Mrs. Ramsay's multifaceted intellect through transparent and unrestricted psychological terminology. It is inevitable to switch from one consciousness to another because everything in Mrs. Ramsay's mind is connected.

Stream of consciousness also demonstrates the complexity and diversity of the human mind, which is intrinsically able to connect seemingly unrelated ideas:

> What she had done with it, Mrs. Ramsay wondered, for Rose's arrangement of the grapes and pears, of the horny pink-lined shell, of the bananas, made her think of a trophy fetched from the bottom of the sea, of Neptune's banquet, of the bunch that hangs with vine leaves over the shoulder of Bacchus (in some picture), among the leopard skins and the torches lolloping red and gold…. (Woolf, p.104-105)

Woolf conveys Mrs. Ramsay's intricate mental links between myths and the distant past through this poetic description of the arrangement of the fruits. Due to its dual-directed nature, this relationship can be thought of as a dialogic connection that never ends. This connection, according to Bakhtin, is expressed through an inconclusive present in which, regardless of how far away this object is in time from us, it is connected to our incomplete present-day, ongoing temporal transitions, and it develops a relationship with our unpreparedness, with our present highlighting the importance of focusing on the here and now rather than on a romanticized or absolute past (Bakhtin, 1981, p. 30). Since there is no priority or superiority of one moment over another, this reflection of time exhibits a certain simultaneity.

These internal monologues of Mrs. Ramsay are therefore, not based on chronological order but rather on associations made by the mind under various circumstances.

Free Association

Free association denotes the idea of exploring the thoughts, ideas, and memories of the characters which are shared randomly without any restrictions. Free association focuses on the reflections on the activities of the thought process. It emerged in the eighteenth century "through the "exteriorized" conceptions of Franz-Anton Mesmer". It is related to the free energy of the ongoing thought process of the mind. It helps to get access to the unconscious mind by bringing out the contents of the conscious mind. Sigmund Freud's psychoanalytic technique greatly influenced Virginia Woolf. She wants to explore the psyche of the characters. The past gets fused with the present in the novel through Stream of the consciousness/ free association method.

The inner thoughts and actions are quite different from each other. The matters, existing in the minds of the characters give readers an idea of the true self of the character. Mrs. Ramasy is not content with Mr. Ramsay, her husband which cannot be traced through her actions. Her inner consciousness expresses the fact of her discontent with her husband. "Raising her eyebrows at the discrepancy—that was what she was thinking, this was what she was doing—ladling out soup—she felt, more and more strongly, outside that eddy" (Woolf, p. 90) .

Interior Monologue

The term "monologue interior" is frequently mistaken for "stream of consciousness". Since it is a rhetorical term and correctly relates to a literary approach, it is employed more precisely than the latter. To be a meaningful critical phrase, however, even this term requires a more specific definition and far more restricted application. Interior monologue, according to Robert Humphrey, a technique employed in fiction to convey the unspoken psychic content and processes of a character, just as these processes occur at varying degrees of conscious control before being articulated into intentional speech (Humphrey, p. 24).

It is important to distinguish between two fundamental forms of interior monologues, which can be categorized as "direct" and "indirect". Direct inner monologue is a sort of interior monologue characterized by minimal author intervention and the absence of an auditor. An examination of its unique techniques reveals that it presents consciousness directly to the reader with minimal author interference; that is, there is either a total or near-total absence of the author from the page, along with his guiding

phrases such as "he said" and "he thought" and with his interpretive comments. It should be highlighted that there is no presumed auditor; the character is not speaking to anyone in the imaginary scenario, nor is the character speaking to the reader (as the speaker of a stage monologue is, for example). The monologue is portrayed as being entirely frank as if there were no audience. This discrepancy is difficult to comprehend, yet it is genuine. Undoubtedly, every author writes ultimately for an audience. Despite the reader's assumptions of normal syntax and diction, the interior monologue continues to portray the true texture of consciousness—i.e. to represent it to the readers.

Indirect internal monologue is the sort of interior monologue in which an omniscient author gives unspoken content as though it came directly from the character's consciousness and guides the reader through it with commentary and description. It is distinct from the direct monologue since the writer gets involved with the character's psychology and the reader. The author serves as a reader's on-the-ground guide. In practice, indirect interior monologue is often paired with one of the stream-of-consciousness techniques, particularly a depiction of the mind. Typically, it is paired with direct monologue. This latter combination of approaches is particularly appropriate and natural, as the author who employs indirect monologue may choose to leave the scene for an extended period after he has introduced the reader to the character's thoughts and made sufficient additional statements to ensure that they can proceed together smoothly.
Virginia Woolf depends most on the indirect interior monologue and does so expertly among the other contemporary authors. Through the employment of this approach, Woolf can achieve a more subtle effect on *To the Lighthouse*. This novel has a considerable deal of straightforward, traditional narrative and description, yet the interior monologue is utilized frequently enough to generate the impression that the protagonists are constantly aware. Let us study the following text from the first chapter of section one:

> Such were the extremes of emotion that Mr. Ramsay excited in his children's breasts by his mere presence; standing, as now, lean as a knife, narrow as the blade of one, grinning sarcastically, not only with the pleasure of disillusioning his son and casting ridicule upon his wife, who was ten thousand times better in every way than he was(James thought) but also with some secret conceit at his accuracy of judgment. What he said was true, It was always true"(Woolf, p. 8) .

The use of brackets in the preceding sentence is crucial because it illustrates that the subsequent description of Mr. Ramsay is not provided by the narrator but rather by the cognitive process of young James. The excerpt above exemplifies the perplexing resemblance between a narrator's speech and omniscient comments. The narrator takes a step back but swiftly returns to state, "What he said was true…."

The author presents the section above in the form of direct narration, but it reveals the characters' consciousness and inner thoughts. Woolf uses her distinctive skills to allow the indirect interior monologue in this passage. First, she employs the conjunction, "for" to indicate the beginning of this monologue, creating a smooth transition from an objective description to the character's inner monologue. Second, she introduces the reader to Mrs. Ramsay's consciousness by using the guiding phrases "she would ask" and "she asked", which allow the reader to wander around unhurriedly in Mrs. Ramsay's mind. Thirdly, she uses semi-colons to emphasize that the consciousness continues. The use of semicolons exemplifies Woolf's mastery of indirect interior monologue, as demonstrated in the following passage:

> Yes, he did say disagreeable things, Mrs. Ramsay admitted; it was odious of him to rub this in, and makes James still more disappointed; but at the same time, she would not let them laugh at him. 'The atheist', they called him; 'the little atheist'. Rose mocked him; … (Woolf, pp. 9-10).

This paragraph highlights the frequently puzzling similarity between a narrator's statement and an omniscient narrator's remarks. It shows, however, that punctuation can sometimes indicate the continuance of awareness in a marvelous manner. The use of semicolons after "they called him" reveals the author's exceptional dexterity. Had she not added a semicolon there, the reader could have easily been deceived into believing that the statement "but at the same time, she would not allow them to laugh at him" is a narrator's comment from a third-person omniscient perspective. So, with the use of semicolons, the reader can quickly identify what is the character's inner monologue and when it starts and stops in this text.

Virginia Woolf's favorite literary device in her works is the use of many parentheses, which serve a variety of purposes. As the following example shows, parentheses might be used to indicate digression and simultaneousness: "Teaching and preaching is beyond human power, Lily suspected. (She was putting away her things)". (Woolf, p. 51) Parentheses can also be used for asides, clarifications, and hints about the current situation. Lily is reflecting on Mr. Bankes in this passage:

> I respect you(she addressed silently him in person) in every atom; you are not vain; you are entirely impersonal; you are finer than Mr. Ramsay; you are the finest human being that I know; you have neither wife nor child(without any sexual feeling, she longed to cherish that loneliness), you live for science (involuntarily, sections of potatoes rose before her eyes); praise would be an insult to you; generous, pure-hearted, heroic man!" (Woolf, p. 29)

Here, parentheses indicate abrupt and temporary shifts in perspective. The story jumps back and forth between Lily's voices, which have been perfectly imitated in tone. Lily's focus on Bankes' austerity reflects not only Bankes' but also her longing for seclusion, as well as her aversion to it. She

wants to see more of Bankes while seeing less of herself at the same time. This contradiction is depicted by the concurrent growth of two registers: the continuation of main phrases inscribing Lily's voice, and the parenthetical interruptions in the corner of Lily's eye. The final pair of brackets narrates a sudden obstructive event in her vision: potatoes rising before her eyes. However, this impediment is also a part of her thought process: it is her skill to conceive psychic disciplines as external things ("So now she always saw, when she thought of Mr. Ramsay's work, a scrubbed kitchen table.")(Woolf, p. 28). The parentheses help render Lily's inner world more clearly and present the exact state of her consciousness.

Woolf's inclusion of interior monologue in the parentheses is also shown in the following passage :

> Such expeditions', said Mr. Ramsay, scraping the ground with his toe, 'are very painful.' Still Lily said nothing. (She is a stock, she is a stone, he said to himself.) ' They are very exhausting,' he said, looking, with a sickly look that nauseated her (he was acting, she felt, this great man was dramatizing himself), at his beautiful hands (Woolf, p. 160).

Again, in this case, parentheses serve as perspective indicators. These are the dividing lines between third-person narration and inward monologue. Woolf creates a smooth and unambiguous transition between the two using brackets. This shows her artistic sophistication.

There is a contextual difference between when Woolf chooses to employ brackets and parentheses in To *the Lighthouse*, even though the traditional usage of brackets and parentheses is for disambiguation and further clarity. "The deserted Ramsay house" is described in the section titled "Time Passes" as being empty and gloomy, "Here Mr. Carmichael, who was reading Virgil, blew out his candle. It was past midnight". (Woolf, p-136). The bracketed narration of Mr. Carmichael exudes a sense of assurance. In addition to putting an end to the day quickly by "blowing out his candle," Mr. Carmichael also makes it clear that it is "midnight" at that moment. The transition from light to darkness and the precision of the timing highlight the definite within the brackets. The use of brackets seems to convey a hard reality and truth that excludes other possibilities.

The sudden disclosure of Mrs. Ramsay's death is also made in severe brackets, but a later mention of it is encircled in parenthesis. When Mrs. McNab returns to the Ramsay home, she observes how "There were boots and shoes; and a brush and comb left on the dressing-table, for all the world as if she expected to come back tomorrow. (She had died very sudden at the end, they said)" (Woolf, p-145). The rhythmic effect that expresses the level of shock felt by characters upon hearing of a death is the distinction between writing in brackets and parentheses. Mrs. Ramsay's initial bracketed death interrupts and halts the rhythm because it is likewise separated into paragraphs, as was the case with Andrew Ramsay's death. However, the

parenthetical death of Mrs. Ramsay serves as a somber but delicate reminder of Mrs. Ramsay's passing. In contrast to the halt of brackets, the parenthesis produces a more reverberating effect.

Conclusion

The interior monologue or free association of the characters takes the novel to a new level of modernism. One character is revealed not through only his or her consciousness rather the character is described through the consciousness of the others.

> we see Mrs. Ramsay not only through her consciousness but through the consciousness of Mr. Ramsay, the child James, Lily Briscoe, Mr. Tansley, and Mr. Bankes. Similarly, we come to know Mr. Ramsay not only through his consciousness but also through the consciousness of Mrs. Ramsay, the young James, Lily Briscoe, and Mr. Bankes. Every character in the novel is presented to us through his consciousness and also through the consciousness of the other characters. At the same time, the characters are occasionally presented to us directly by the all-knowing author of the novel, and also sometimes bits of conversation or dialogue between the characters. (Ali, n.d.)

The use of interior monologues helps the readers to have access to the end of the characters. The novelist intelligently controls the authority of narrating the incidents of the novel. She has developed the material of the novel uniquely. It starts with Lily on the lawn of Mr. Ramsay and ends with her vision and completing the picture. Woolf's use of interior monologues which are closely associated with free association makes it easy for her to make several statements and concepts into these mental soliloquies which are outside of the mental range of the characters.

Woolf has given a wonderful presentation of the novel's structure using the stream-of-consciousness method. In the last chapter, the readers find the physical presence of the characters of Lily Briscoe, Mr. Ramsay, James, and Cam who are united. The readers will find it fascinating that persons like Mrs. Ramsay, Charles Tansley, Mrs. Carmichael, and Minta are physically absent but they are active in the sense of the present characters at the end of the novel.

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Development of Concrete Strength Models Incorporated with Recycled Aggregates

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Abstract: A huge amount of waste like waste tires, fly-ash, rice husk ash, stone dust etc. are accumulated in a dreadful way causing serious environmental pollution. At the same time, due to rapid modernization the demand of natural aggregates for construction wastes is increasing expeditiously. To minimize the mentioned problems recently much research has been conducted on concrete incorporated with recycled aggregates. The compressive strength of concrete is considered as the most important and primary index for determining the quality of concrete. Early prediction of concrete strength is a key factor for conducting construction projects more efficiently and effectively. An attempt is made to predict the compressive strength of concrete incorporated with rubber aggregates (RA) (as a partial replacement of 10% and 30% of coarse aggregates and fine aggregates) and concrete with fly ash (FaH), rice husk ash (RHA) and stone dust (StD) as a partial replacement of 5% and 10%. The variables used for the prediction of concrete strength are water cement ratio (W/C) and quantities of mixed design elements such as cement, Rice Husk Ash, Fly Ash, and Stone dust. The coefficients of regressions (CORs) were determined for concrete strength prediction and found to be 0.8524, 0.8599, 0.9024, 0.8538, 0.9583 and 0.53 for concrete with ground rubber, crumbed rubber, ground and crumbed rubber, fly ash, rice husk ash and, stone dust respectively at 28 days curing.

Keywords**:** Concrete Strength, Rubber Aggregates, Fly Ash, Rice Husk Ash, Stone Dust, Multiple Regression Analysis, Strength Prediction, Strength Model.

Introduction

Concrete is a versatile product that has changed the way of construction. It is used tremendously as construction materials calling for a huge number of natural aggregates that adversely affect the natural resources. On the other hand, worldwide accumulation of different waste products is increasing day by day making the environment polluted. By conducting research on the basic ingredients of concrete, many researchers have developed concrete incorporated with these by-products that not only possess sufficient compressive strength but are also durable in nature. The compressive strength of concrete varies for different concrete mixtures and even in the

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same mixtures for different parameters (Zelić et al., 2004). The strength of concrete is determined by several factors, including the type of cement used, the water-cement ratio, the curing conditions, and the aggregate properties. Concrete strength is critical in the design and construction of structures such as buildings, bridges, and roads. The strength of the concrete used in these structures must be sufficient to withstand the loads and stresses it will be subjected to over its lifetime. A concrete structure that is not strong enough will crack or fail under load, leading to costly repairs or even collapse. By ensuring that the concrete used in construction is of sufficient strength, the lifespan and durability of the structure can be increased. Efforts in maintaining the concrete compressive strength and use of by-products such as waste tires, fly ash (FaH), rice husk ash (RHA) (Zaid et al., 2021), stone dust (StD) (Suman et al., 2015), limestone wastes, slag (Smith et al., 2012) and glass materials as a partial replacement of aggregates has created a way for preserving the natural aggregates. The variation of concrete compressive strength depends on the mixed design. Sometimes, errors in mix design may lead to failure in achieving the desired concrete strength. This results in the repetition of the entire process of concrete preparation which is not only costly but also consumes a lot of time, at least 28 days. So, the prediction of concrete strength can lead a way to resolve this problem considerably.

A suitable concrete strength prediction model would be of great significance. Therefore, many investigations are being carried out to inspect the behavior of concrete and to establish better prediction criteria for its compressive strength. As the use of by-products in concrete has brought a significant improvement in concrete strength, the prediction of the compressive strength of concrete incorporated with by-products is an important matter. Different models have been used recently by many researchers. Among them, Multiple Linear Regression (MLR) is used successfully for the prediction of concrete strength. Chen (2010) used MLR to predict the compressive strength of concrete with electric arc furnace slag and claimed that MLR can be used successfully for prediction purposes. Chopra et al. (2014b) found out that MLR models can predict the compressive strength of concrete with 95% accuracy at 28 and 58 days. In our investigation we will mainly focus on two types of concretes, i.e., concrete with rubber aggregates. The main objectives of our research are to study about replacement of the optimum level of fine aggregates, coarse aggregates, and cement, establish a relationship between the strength of natural concrete and recycled aggregates concrete and finally develop a strength model of concrete using multiple linear regression analysis.

Literature Review

Chopra et al. (2014a) conducted a mathematical analysis using statistical techniques to predict the compressive strength of concrete based on data obtained from laboratory experiments conducted in their study. They used

mixed proportioning elements as variables in their prediction models. The multiple non-linear regression models showed high correlation coefficients for predicting compressive strength at different curing ages (28, 56, and 91 days), as well as for variations such as the use of fly ash as a partial replacement for cement and changes in the zone of coarse aggregates. FM Zain and M Abd (2009) performed multiple regression analysis to predict compressive strength of high-performance concrete. In this study, statistical data from experiments were used to create a mathematical model to predict the compressive strength of high-performance concrete. Multiple non-linear regression models were employed to determine the correlation coefficient for predicting strength at different ages (3, 7, 14, 28, and 91 days). The correlation coefficient was found to be 99.99% for each strength at each age, indicating excellent predictability. Additionally, the model performed well in predicting strength for concrete samples subjected to different curing methods. Chopra et al. (2014b) find out the compressive strength of concrete for varying workability using regression models. The compressive strength of concrete was predicted using a mathematical analysis that employed statistical techniques.

The multiple non-linear regression models developed in this study yielded excellent coefficients of determination (CODs) for predicting compressive strength at different curing ages (28, 56, and 91 days). The results showed that both models developed in this study could predict the compressive strength at 28 and 91 days with over 95% accuracy. Chithra et al. (2016) conducted a study to compare the compressive strength prediction models of High-Performance Concrete containing nano silica and copper slag using both regression analysis and Artificial Neural Networks.

In this study, researchers used Multiple Regression Analysis (MRA) and Artificial Neural Network (ANN) models to predict the compressive strength of High-Performance Concrete that contained nano silica and copper slag as partial replacements for cement and fine aggregate, respectively. The data used to construct the models were obtained from laboratory experiments in which the compressive strength of specimens containing varying amounts of nano silica and copper slag were determined at curing ages of 1, 3, 7, 28, 56, and 90 days. Kabir et al. (2013) aimed to develop a mathematical model that predicts the compressive strength of concrete at any age using the early compressive strength test result. The study investigated the potential use of early-day compressive strength results to estimate the characteristic strength of normal weight concrete.

The analysis demonstrated reliable prediction of concrete strength at different ages (7, 14, 28 days, etc.) with excellent efficiency. Nambiar and Ramamurthy (2008) when dealing with aerated or foam concrete where air voids play a significant role in the volume of voids, more generalized expressions that include the volume of air voids must be developed, aimed

of this paper is to propose prediction models for the compressive strength of foam concrete by extending two well-known models for cement paste, mortar, and normal concrete, namely Balshin's strength-porosity model and Power's gel-space ratio equation. However, the strength-porosity model is preferred over the gel-space model because it correlates better with measured strength and is easier to apply, as it utilizes the composition of constituents and easily measurable parameters.

Materials and Methods

Materials property from case study I

For rubberized concrete, Portland Composite Cement (PCC) was used. The chemical properties of the PCC as indicated by the manufacturing company were 65-79% clinker, fly ash, 21-35% slag, limestone and 0-5% gypsum. The specific gravity and initial setting time of the PCC was 2.98 and 1 h 47 min. For coarse aggregates, black stone chips with a nominal size of 20 mm having fineness modulus (FM) and unit weight of 2.44 and 1523.04 kg/m^3 respectively were used. Localized river sand with FM 2.14 was considered for fine aggregates. On the other hand, rubber aggregates of varying sizes 16 mm to 25 mm were used for CA replacement and up to 1mm of crumbed rubber was for fine aggregates replacement.

Materials property from case study II

For concrete incorporated with FaH, RHA and StD, Ordinary Portland cement (OPC, Grade-43), river sand (Specific gravity 2.60 and Fineness modulus 2.50), completely burnt RHA (100% passing through 150 mesh sieve, Specific gravity 2.01, SiO_2 79.7%, Specific surface area 19.7 m^2/kg, average particle size 90-100 microns and bulk density 106 kg/m^3), FaH (SiO_2 + Al_2O_3 + Fe_2O_3 > 75%, 2% loss on ignition and 2.15% CaO) and StD (100% passing through 4.75mm sieve and 24% retained on 1mm sieve, Specific gravity 2.63 and Fineness modulus 2.80 were used. Normal drinking water at room temperature was considered for both cases.

Data Collection

2 groups of data having 5 data sets with different mix designs have been selected for developing the mathematical model that was carried out recently in the concrete laboratory of Pabna University of Science and Technology (PUST). The first group of data was for rubberized concrete where ground rubber and crumbed rubber were used as partial replacement of coarse aggregates and fine aggregates. The samples of rubberized concrete with varying replacement were identified as RC0F0, RC10F0, RC0F10, RC30F0 and RC0F30 where C0, C10, and C30 represent the partials replacement in percentage of coarse aggregates by crumbed rubber

and F0, F10, and F30 represents the partials replacement in the percentage of fine aggregates by ground rubber. The 2nd group of data was for the concrete incorporated with FaH, RHA and StD and the replacement levels were 5% and 10% and the sample was identified as F0R0S0, F5R10S0, F10R5S0, F10R10S5 and F5R5S10. After selecting the data sets, 5 different models considering different variables have been developed using MLR analysis. For example, in model 1 the variables that are used for the strength models are water/cement ratio, cement, ChR and stone chips. For this model, coarse aggregates are replaced by crumbed rubber. In a similar way the rest of the 4 models are evolved. The CORs for each model have been found and strength prediction models are validated with the datasets that are not used for the MLR analysis. The observed compressive strength and predicted compressive strength were then compared for each model for the same 28 curing days.

Table-1: **Materials Properties from Case Study I**

Case Study	Materials	Properties		Ref.
I	**Cement:** Portland Composite Cement (PCC)	Physical property: • Specific gravity = 2.98 • Initial setting time = 1 h 47 min Chemical property: • Clinker = 65-79 % • Slag = 21-35 % • Gypsum = 0-5 %		(Islam et al., 2021)
	Coarse aggregates	Black stone chips	• Nominal size = 20 mm • Fineness modulus = 2.44 • Specific gravity = 2.58 • Unit weight = 1523.04 kg/m^3	
		Crumb Rubber (ChR)	• Nominal size = 16mm to 25mm • Fineness modulus = 2.46 • Specific gravity = 2.54 • Unit weight = 1528 kg/m^3	
	Fine aggregates	Localized river	• Fineness modulus = 2.14	

Case Study	Materials	Properties		Ref.
		coarse sand	• Unit weight = 1578.2 kg/m^3 • Specific gravity = 2.62	
		Ground rubber (GrR)	• Nominal size = 4.75 mm downgraded	

Table-2: **Materials Properties from Case Study II**

Case Study	Materials	Properties	Ref.
II	Ordinary Portland Cement (OPC)	• Grade = 43	(Siddika et al., 2021)
	Coarse sand	• Specific gravity = 2.60 • Fineness modulus = 2.50	
	Fly ash (FaH)	• Class = F • Oxide components (SiO_2 + Al_2O_3 + Fe_2O_3) > 75 % • CaO = 2.15 % • Loss on ignition = 2%	
	Rice husk ash (RHA)	• Average sizes = 90-100 micron • Specific gravity = 2.01 • Bulk density = 106 kg/m^3 • Specific surface area = 19.7 m^2/kg • SiO_2 = 79.7 %	
	Stone dust (StD)	• Specific gravity = 2.63 • Fineness modulus = 2.80	
	Crushed stone	• Nominal size = 20 mm downgraded • Specific gravity = 2.64	

Mix Design

For establishing the foundation of a sound structure, proper mix design of concrete is of greater importance. There are several factors that influence the mix design such as choice of cement, aggregates optimum sizes, fine aggregates, coarse aggregates, water, grade, coarse aggregates/ total aggregates ratio, and w/c ratio. For definite strength, workability and

durability of concrete, a suitable w/c ratio must be selected (Ahmad, 2007). In the investigation of rubberized concrete, the concrete mix proportion was 1 (Cement):1.5 (Fine Aggregates): 3 (Coarse Aggregates) for producing M30 grade concrete with a w/c of 0.45. For concrete incorporated with FaH, RHA and StD, the mix proportion was considered as 1 (Cement):2 (Coarse Sand):4 (Coarse Aggregates) with a varying w/c ratio 05-0.69 (Siddika et al., 2021). The quantity of aggregates that were replaced by the recycled aggregates was calculated according to these proportions for both cases. The mix proportions for both recycled aggregates concrete are given in Tables 03 and 04.

Table-3: Mix Proportion for Rubberized Concrete

% Sand replaced by Ground Rubbers (GrR)	% Stone chips replaced by Crumbed Rubbers	ID	w/c ratio	Cement, kg/m^3	GrR, kg/m^3	Crumbed Rubbers, kg/m^3	Sand, kg/m^3	Stone chips, kg/m^3
0	0	RC_0F_0 (S1)	0.45	668.36	0	0	1002.6	2005.09
0	10	$RC_{10}F_0$ (S2)	0.45	668.36	0	200.51	1002.6	1804.58
10	0	RC_0F_{10} (S3)	0.45	668.36	100.25	0	902.3	2005.09
0	30	$RC_{30}F_0$ (S4)	0.45	668.36	0	601.53	1002.6	1403.56
30	0	RC_0F_{30} (S5)	0.45	668.36	300.76	0	701.78	2005.09

Table-4: Mix Proportion for concrete incorporated with FaH, RHA and StD (Siddika et al., 2021)

Specimen ID	Constituents (kg/m^3)						
	Cement	Water	FaH	RHA	Fine aggregates	StD	Coarse aggre-gates
$F_0R_0S_0$ (S6)	380	190	0	0	760	0	1520
$F_5R_{10}S_0$ (S7)	323	190	19	38	760	0	1520
$F_{10}R_5S_0$ (S8)	323	190	38	19	760	0	1520
$F_{10}R_{10}S_5$ (S9)	304	190	38	38	722	38	1520
$F_5R_5S_{10}$ (S10)	342	190	19	19	684	76	1520

Results and Discussions

The strength of concrete is significantly impacted by the cement content, the quantity of fine and coarse aggregate used, and any additional materials added to enhance specific properties, such as fly ash, rice husk ash, stone dush, rubber aggregates etc. in our investigations, the regression analysis is carried out on the data set in Table 3 and 4 to develop 6 strength models of concrete incorporated with RA, RHA, StD, and FaH for 28 days curing period. The regression analysis was performed in Microsoft Excel software. For the strength model, the compressive strength of concrete is taken as a dependent variable and w/c, Chr, GrR, StD, FaH and, RHA is taken as an independent variable.

Strength Prediction Modelling

Multiple linear regression (MLR) is a statistical technique that can predict quickly and is easier to perform. MLR is a model that uses two or more independent variables for the prediction of one dependent variable. The most common linear regression equation that is known as Abram's law (Popovics & Ujhelyi, 2008) used by researchers for the prediction of compressive strength of concrete is:

$$f_c = m_0 + m_1\, w/c \tag{1}$$

Where, f_c is the Compressive Strength of concrete, MPa, m_0, m_1 are Coefficients of regression and, w/c is the water/cement ratio. Equation (1) is the linear regression equation that originated from Abram's Law. This law establishes a relationship between the compressive strength of concrete and the water-to-cement (w/c) ratio in the mix. According to this law, an increase in the w/c ratio will result in a decrease in the strength of the concrete. The original formula for Abram outlines this relationship as:

$$f_c = \frac{Ä}{Ḃ^{w/c}} \tag{2}$$

Where, $f_c$is Compressive Strength of concrete, MPa and $Ä$, $Ḃ$ are Coefficients of regression.

As the concrete mix includes coarse aggregates, fine aggregates and cement with a definite proportion, the compressive strength of concrete is also dependent on these variables. So,the prediction of concrete strength considering only the w/c ratio will give actual results is not true always. Hence, concentration on each variable related to concrete mix design should be made to provide a more accurate and authentic prediction of concrete strength. Equation 1 is extended to include all of these variables,

$$fc = p_0 + \frac{p_1 w}{c} + p_2\,CAs + p_3\,FAs + Ce \quad (3)$$

Where, f_c is Compressive Strength of concrete, MPa, p_0, p_1, p_2, and p_3 are Coefficients of regressions, w/c is the Water/cement ratio, CAs is the quantity of coarse aggregate in the mix, FAs is the quantity of fine aggregate in the mix and Ce is the quantity of cement in the mix. The considered variables for the development of models are shown in Table 05.

Table-5: Strength Models with Different Variables

Model	Samples	Replacement levels	Considered Variables
1	RC_0F_0, $RC_{10}F_0$, $RC_{30}F_0$ RC_0F_{10}, and RC_0F_{30}	10% and 30%	w/c, ChR, and stone chips
2	RC_0F_0, $RC_{10}F_0$, $RC_{30}F_0$ RC_0F_{10}, RC_0F_{30}	10% and 30%	w/c, GrR, and stone chips
3	RC_0F_0, $RC_{10}F_0$, $RC_{30}F_0$ RC_0F_{10}, and RC_0F_{30}, RC_0F_0, $RC_{10}F_0$, $RC_{30}F_0$ RC_0F_{10}, and RC_0F_{30}	10% and 30%	w/c, ChR, GrR and stone chips
4	$F_0R_0S_0$, $F_5R_{10}S_0$, $F_{10}R_5S_0$, $F_{10}R_{10}S_5$ and $F_5R_5S_{10}$	5% and 10%	w/c, FAs, CAs and FaH
5	$F_0R_0S_0$, $F_5R_{10}S_0$, $F_{10}R_5S_0$, $F_{10}R_{10}S_5$ and $F_5R_5S_{10}$	5% and 10%	w/c, FAs, CAs and RHA
6	$F_0R_0S_0$, $F_5R_{10}S_0$, $F_{10}R_5S_0$, $F_{10}R_{10}S_5$ and $F_5R_5S_{10}$	5% and 10%	w/c, FAs, CAs and StD

In the meantime, Equation (3) is further modified to include all these materials for the prediction of the compressive strength of concrete. The general equation for the prediction of rubberized concrete compressive strength may be as follows:

Model 1: $f_{GrR} = p_0 + p_1\ w/c + p_2\,GrR + p_3\,S + p_3\,StC$ (4)

Model 2: $f_{ChR} = p_0 + p_1\ w/c + p_2\,ChR + p_3\,S$ (5)

Model 3: $f_{ChR\ \&\ GrR} = p_0 + p_1\ w/c + p_2\,GrR + p_3 ChR + p_4 StC + p_5\,S$ (6)

Where, f_{ChR} is compressive strength of rubberized concrete with ChR (MPa), f_{GrR} is compressive strength of rubberized concrete with GrR

(MPa), p_0, $p_1 \ldots p_3$ are Coefficients of regressions (CORs), ChR is the quantity of crumbed rubber (kg), GrR is Quantity of ground rubber (kg) and, S is the quantity of sand (kg). The regression equations for the prediction of the compressive strength of concrete incorporated with FaH, RHA an StD may as follows:

Model 4: $f_{FaH} = q_0 + q_1\ \mathrm{w/c} + q_2\ \mathrm{FAs} + q_3\ \mathrm{Cas} + q_4\ FaH$ (7)

Model 5: $f_{RhA} = q_0 + q_1\ \mathrm{w/c} + q_2\ \mathrm{FAs} + q_3\ \mathrm{CAs} + q_4\ RHA$ (8)

Model 6: $f_{StD} = q_0 + q_1\ \mathrm{w/c} + q_2\ \mathrm{FAs} + q_3\ \mathrm{CAs} + q_4\ StD$ (9)

Here, f_{FaH} is the compressive strength of concrete with FaH (MPa), f_{RhA} is compressive strength of concrete with RHA (MPa), f_{StD} is compressive strength of concrete with StD (MPa), q_0, $q_1 \ldots q_4$ are Coefficients of regressions (CORs), FaH is the quantity of fly ash (kg), RHA is the quantity of rice husk ash (kg), StD is the quantity of stone dust (kg), FAs is the quantity of fine aggregates (kg) and CAs is the quantity of coarse aggregates (kg).

Table-6: Coefficients of Regression for the Strength Model 1-6 for 28 Days

Samples (S1-S5)						
CORs	**Parameters**	**Model 1**	**Parameters**	**Model 2**	**Parameters**	**Model 3**
p_0	Intercept	256227.6	Intercept	-12.64	Intercept	20.1
p_1	w/c	0	w/c	0	w/c	0
p_2	GrR	-255.7	ChR	-0.0281	ChR	-0.028
p_3	Sand	-255.6	Sand	0.0326	GrR	-0.033
p_4	StC	0.0286	StC	0	-	-
Samples (S6 – S10)						
Parameters	**CORs**	**Model 4**	**Parameters**	**Model 5**	**Parameters**	**Model 6**
Intercept	q_0	41.4	Intercept	18.6	Intercept	26.25
w/c	q_1	-35.4	w/c	12.2	w/c	-13.3
FAs	q_2	-0.005	FAs	-0.006	FAs	0
CAs	q_3	0	CAs	0	CAs	0
FaH	q_4	0.0724	RHA	-0.0832	StD	0.005

From Table 06, we can observe that for model 1 both sand and ground rubber have the highest correlation with the predicted strength. The correlation of w/c (0.45) is zero as it was taken as constant throughout the samples. Stone chips hold little correlation with the predicted compressive strength. As for model 2 and 3 ChR have the same effect and GrR has the highest correlation with the predicted strength. For concrete incorporated with fly ash w/c holds the highest correlation with the predicted strength. The effects of coarse aggregates and fine aggregates are considerably minimal. On the other hand, for model 5 and 6 w/c ratio has the highest effect on the predicted strength. In the case of stone dust, the effect is negligible.

Data Validation

The effectiveness and credibility of a model primarily rely on how well it performs. One widely used approach to assess performance is through statistical parameters. This involves comparing the output results obtained from the model with observed data from the field or laboratory. To verify the accuracy of the proposed model for predicting the 28-day compressive strength of concrete for any dataset, it was essential to conduct a comparison by applying the model to data from other sources or other researchers. This comparison is crucial to test the validity of the proposed model. To verify the accuracy of the model, a separate set of compressive strength data was used, which was not included in the initial model development. The regression coefficients obtained from this validation process were then incorporated into equations to obtain the final model for predicting concrete compressive strength in 28 days.

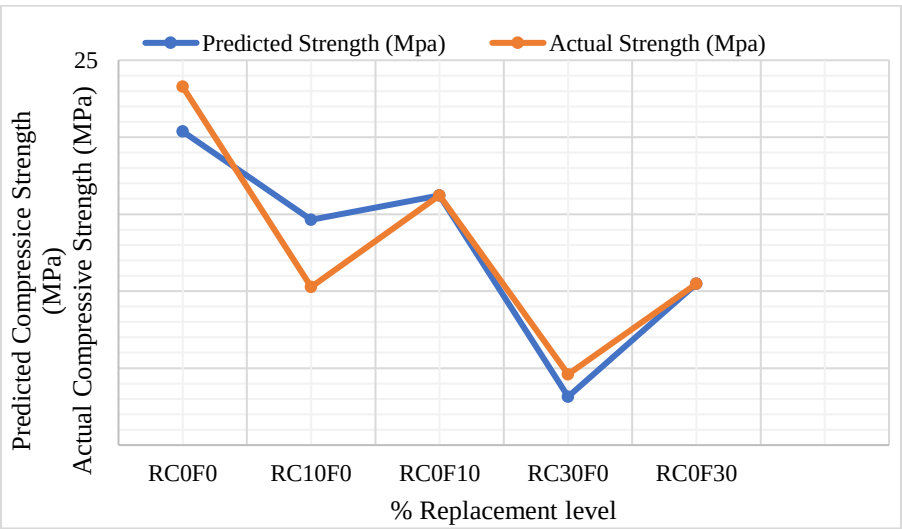

Figure-1: Actual and predicted strength (MPa) for model 01

Figures 01 and 02 show the correlation between the predicted values obtained using the proposed model for the 28-day compressive strength of concrete and the observed or actual values obtained from experimental work for model 01. The results indicate that almost 85.24% of the data points are located on the line of equality, which signifies that the actual and predicted values for the concrete compressive strength are nearly identical. This is supported by the high correlation coefficients of 0.8524 for the 28-day prediction. From the figures, we can also observe that for sample 2 with a 10% partial replacement of fine aggregates by ground rubber, there is a significant variation between the actual strength and the predicted strength by the model developed in this research. Almost 30% variation in strength is found for sample 2 followed by sample 1 with 13% variance. After comparing all the samples' strengths, the model is found to be effective for predicting the strength of concrete at 28 days.

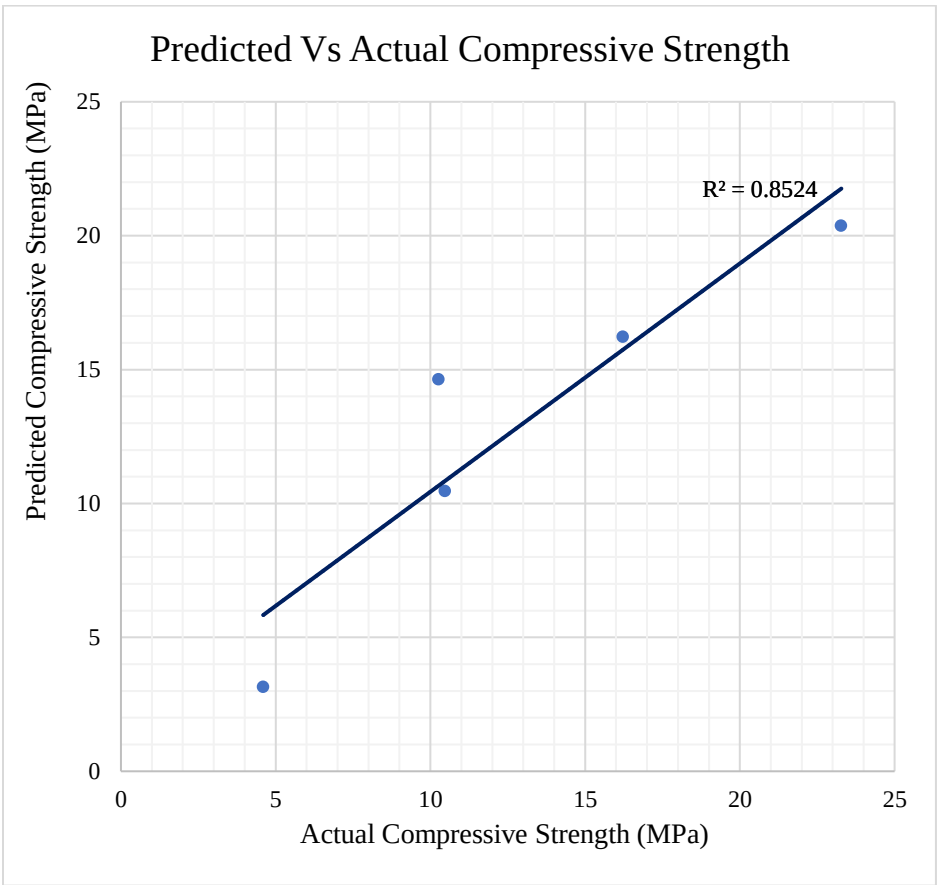

Figure-2: Actual vs predicted strength (MPa) for model 01

Figure-3: Actual and predicted strength (MPa) for model 02

Figures 3 and 4 show the correlation between the predicted values obtained using the proposed model for the 28-day compressive strength of concrete and the observed or actual values obtained from experimental work for model 02. The results indicate that almost 84.99% of the data points are located on the line of equality, which signifies that the actual and predicted values for the concrete compressive strength are nearly identical. This is supported by the high correlation coefficients of 0.8499 for the 28-day prediction. From the figures we can also observe that for sample 2 with 10% partial replacement of fine aggregates by crumbed rubber, there is a significant variation between the actual strength and the predicted strength by the model developed in this research. Almost 29% variation in strength is found for sample 2 followed by sample 1 with 14% variance. After comparing all the samples' strength, the model is found to be effective for predicting the strength of concrete at 28 days.

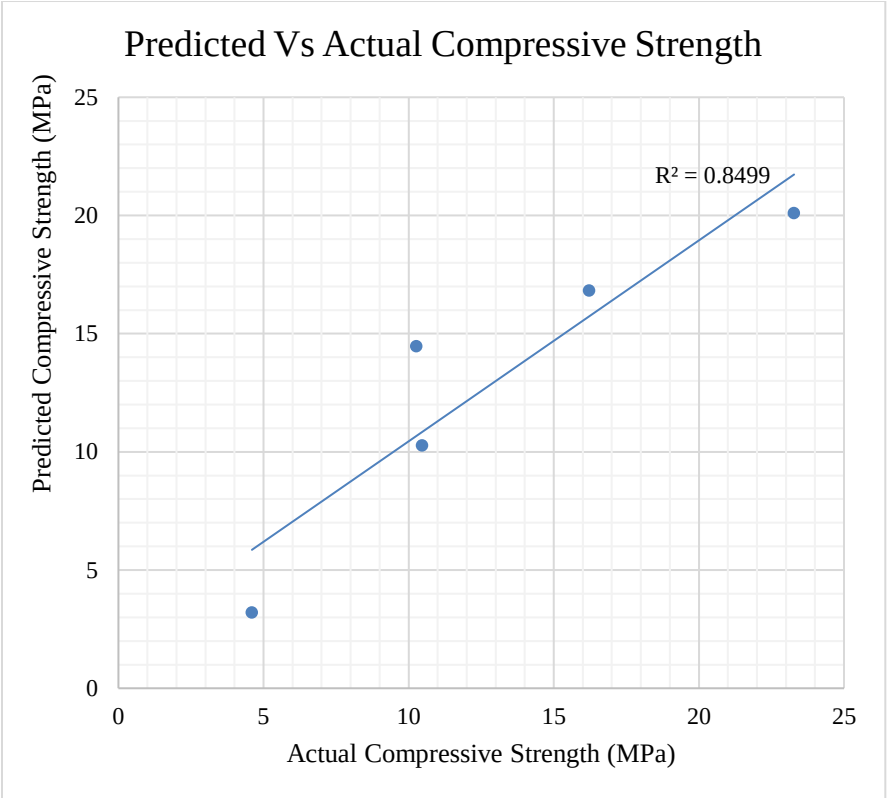

Figure-4: Actual vs predicted strength (MPa) for model 02

In a similar way, we have found that the R-Square values for models 3, 4, 5 and 6 are around 90%, 85%, 96% and 53% respectively. So, every model has a high correlation with the predicted strength and these models can be accepted as satisfactory. But in the case of model 6, we found a 53% correlation. From the figure we can also observe that for all the samples with 5% and 10% partial replacement of fine aggregates and cement by stone dust, there is a significant variation between the actual strength and the predicted strength by the model developed in this research. So, further modification is required for the model 6.

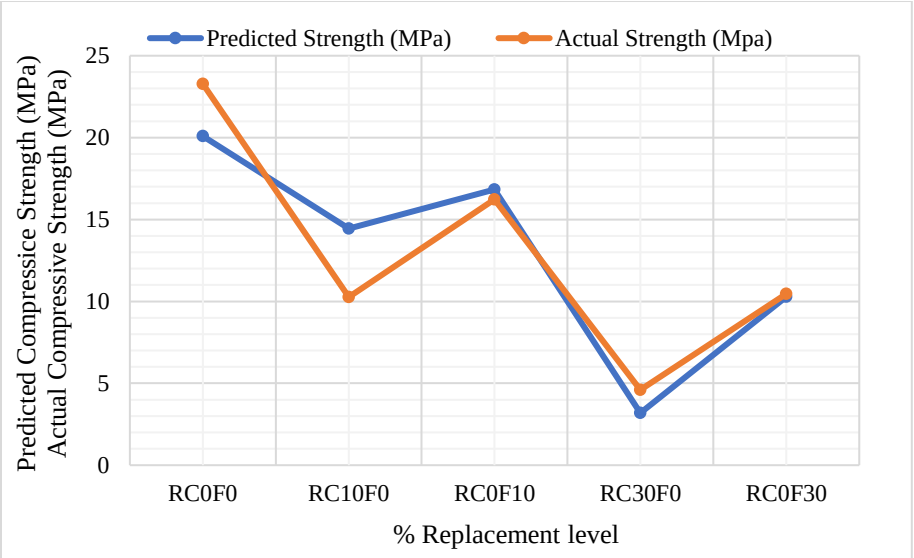

Figure-5: Actual and predicted strength (MPa) for model 03

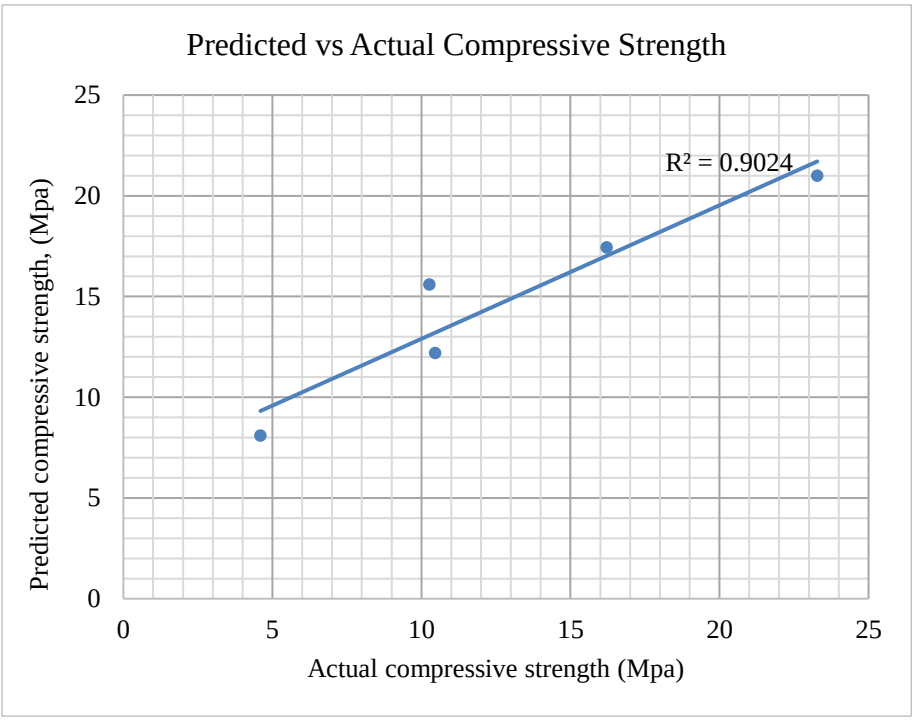

Figure-6: Actual vs predicted strength (MPa) for model 03

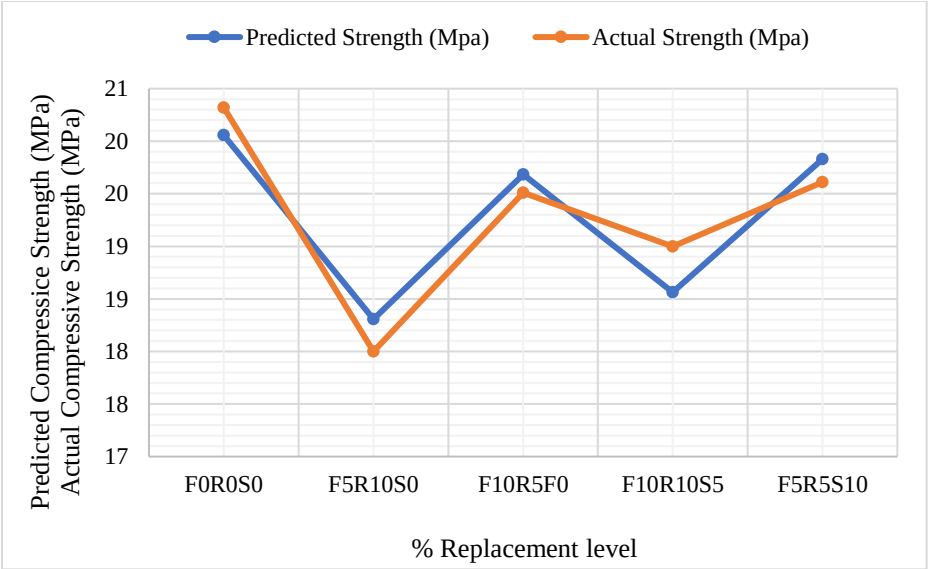

Figure-7: Actual and predicted strength (MPa) for model 04

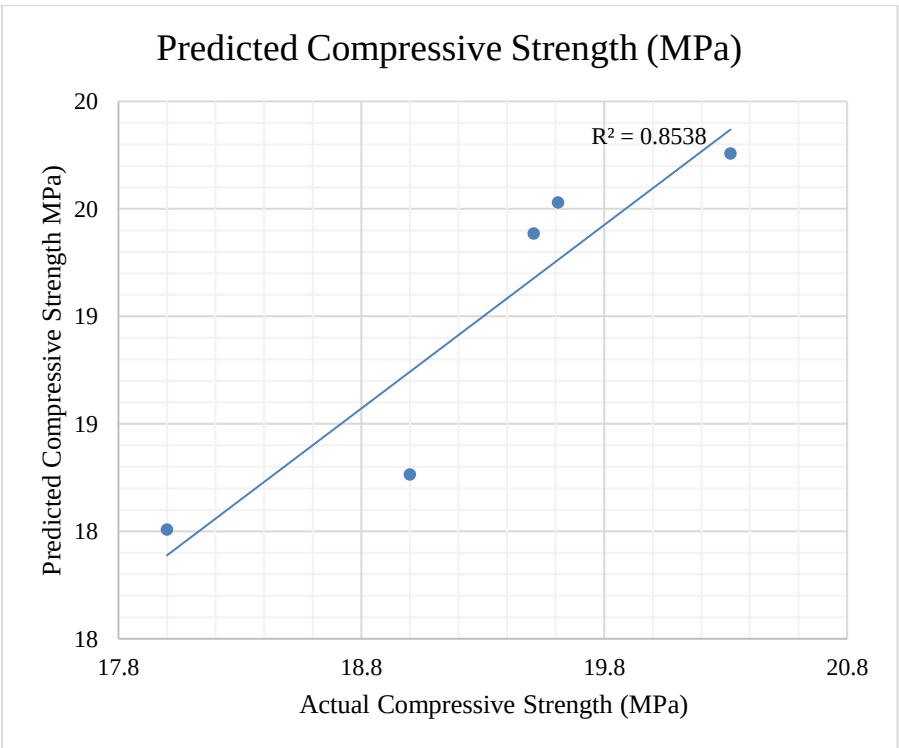

Figure-8: Actual vs predicted strength (MPa) for model 04

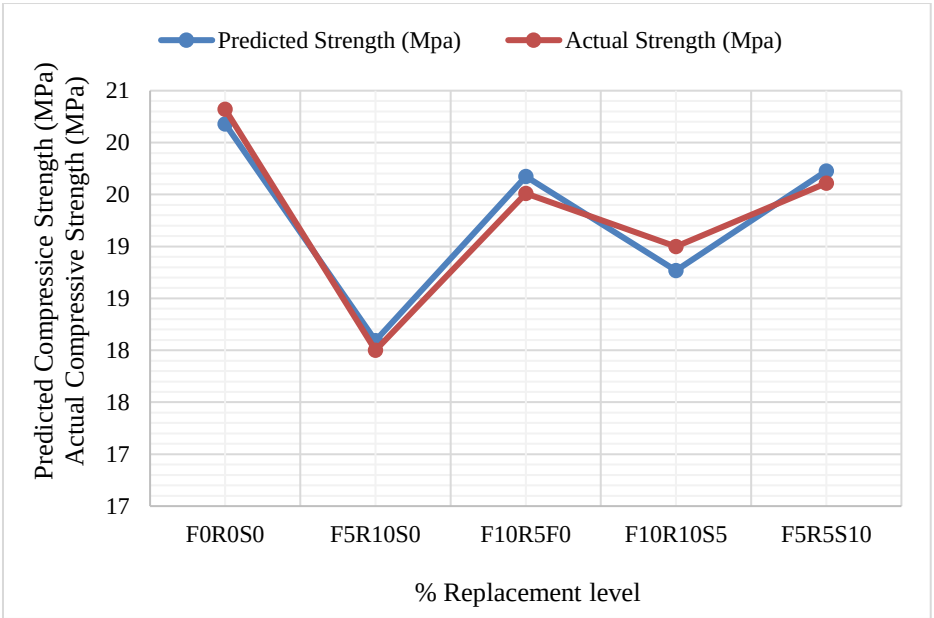

Figure-9: Actual and predicted strength (MPa) for model 05

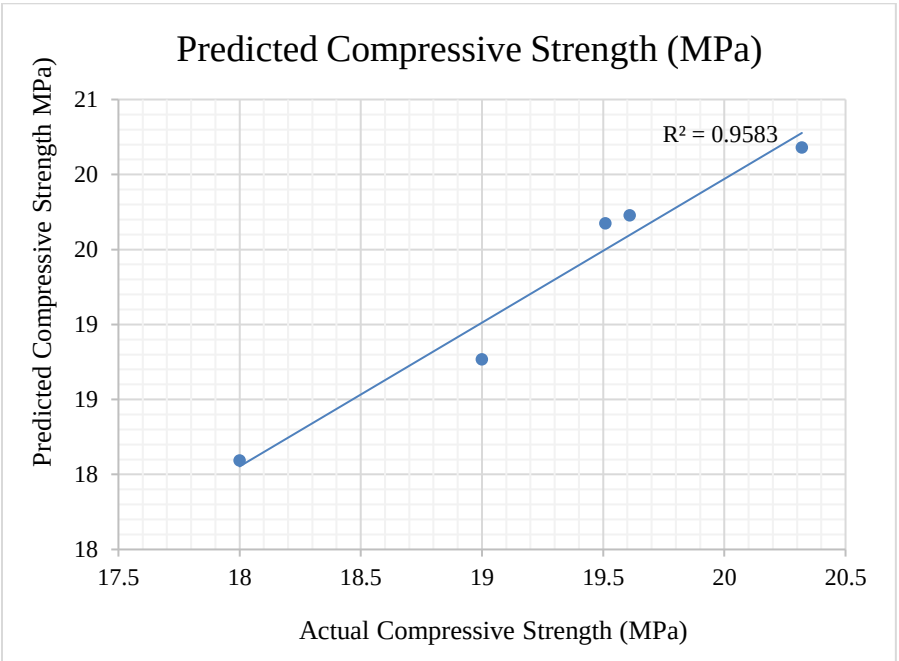

Figure-10: Actual vs predicted strength (MPa) for model 05

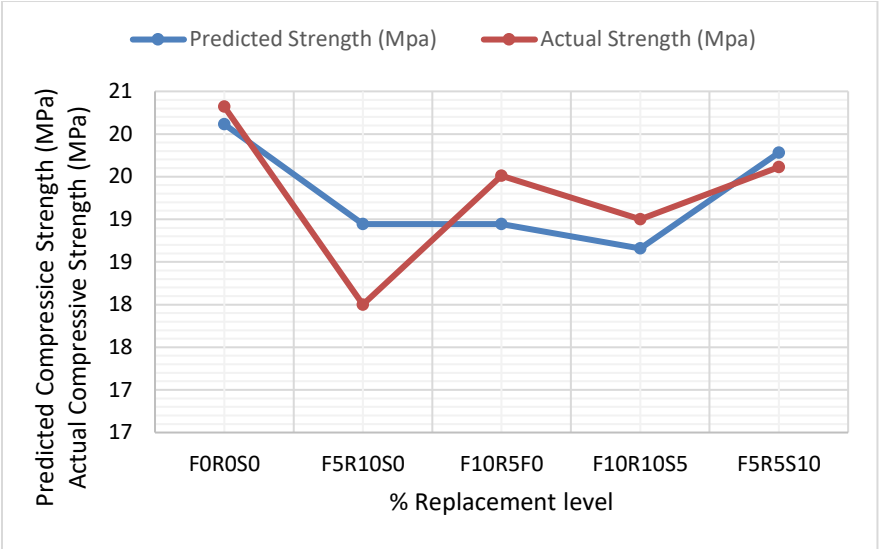

Figure-11: Actual and predicted strength (MPa) for model 06

Thus, the final models for predicting the compressive strength of concrete with recycled aggregates of M30 grade concrete using the coefficients of regression in Table are formulated below.

For Rubberized Concrete (w/c is constant):

$$f_{GrR} = 256227.6 + (-255.7)\mathrm{GrR} + (-255.6)S + 0.0286\ \mathrm{StC} \quad (10)$$

$$f_{ChR} = -12.6 + (-0.028)\mathrm{ChR} + (0.0326)S \quad (11)$$

$$f_{ChR\ \&\ GrR} = 20.9 + (-0.033)\mathrm{GrR} + (-0.028)ChR \quad (12)$$

For concrete with FaH, RHA, and StD:

$$f_{FaH} = 41.4 + (-35.4)\ \mathrm{w/c} + (-0.005)\mathrm{FAs} + (0.0724)FaH \quad (13)$$

$$f_{RHA} = 18.6 + 12.2\ \mathrm{w/c} + (-0.006)\mathrm{FAs} + (-0.083)RHA \quad (14)$$

$$f_{StD} = 26.25 + (-13.3)\mathrm{w/c} + (0.005)StD \quad (15)$$

Conclusion

This study aims to develop more reasonable strength models that will help to know the concrete strength on site. 6 models with different variables have been developed. The outcomes of this study are as follows:

(i) Allows a fast and accurate prediction of compressive strength on site. The significance of the impact that the constituents of a concrete mix have on its strength has been validated.

(ii) For concrete with GrR (10% and 30% replacement of FAs), taking the w/c constant, the significance of GrR and FAs is found to be the same for the prediction model. The R-square for the model is found 85.24% which suggests that the observed values and the predicted values for concrete's compressive strength are consistent with each other, indicating that the predictions are dependable. This can be interpreted as an affirmation of the reliability of compressive strength predictions.

(iii) For concrete with ChR (10% and 30% replacement of CAs), taking the w/c constant, FAs are found to have the highest correlation than ChR for the prediction of concrete strength and the R-Square value is 85%.

(iv) For concrete with ChR and GrR combinedly (10% and 30% replacement of FAs and CAs respectively), taking the w/c constant, GrR has higher correlation than ChR for the prediction of compressive strength. The R-square is found 99%.

(v) For model 4, concrete with FaH (5% and 10% replacement of FAs), w/c has the highest correlation with the predicted strength. The R-square for the model is found 85% which suggests that the observed values and the predicted values for concrete's compressive strength are consistent with each other, indicating that the predictions are dependable. This can be interpreted as an affirmation of the reliability of compressive strength predictions.

(vi) For concrete with RHA and StD, w/c has a greater impact for prediction purposes. On the other hand, the effect of FAs, CAs and StD is found to be very low. The R-square values are 0.96 and 0.53 respectively.

(vii) The developed models are validated for strength prediction and can be used sufficiently for strength prediction.

Recommendations

There are some recommendations for further study about this research work:

- ✓ Variables for establishing the strength model should be as less as possible to get a strength model with higher accuracy.
- ✓ A higher number of research works related to this should be studied thoroughly.
- ✓ For getting accurate strength prediction the workability of concrete should be higher. So, mixed proportions should be followed accurately.

- ✓ For obtaining an accurate strength model, multiple methods should be compared.

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Analysis of the ICT Integration in Digitalizing Madrasah Education: A Study on Rajbari District

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***Abstract*:** Tailored to foster 21st century skills, Madrasah education is strategically prioritized in conjunction with general and technical education. The government offers various ICT training programs aimed at elevating the quality of Madrasah education, ultimately enhancing its competitiveness. This study delves into the state of Madrasah education in Rajbari district, specifically examining the utilization of ICT in teaching and learning practices. The study followed the exploratory mixed method, integrating both qualitative and quantitative approaches. The sample encompasses Superintendents, Assistant Superintendents, Teachers, Students, and office Staffs from 10 Madrasahs, along with representatives from the Upazilla Secondary Education Officer (USEO), high officials from Directorate of Madrasah Education, Madrasah Education Board, a2i, and Bangladesh Madrash Teachers' Training Institute (BMTTI). Data collection involves a comprehensive questionnaire, semi-structured interviews, FGD, and a class observation. The primary data is meticulously analyzed using descriptive statistics. The findings reveal that a majority of Madrasah teachers undergo Basic Teacher Training in ICT. However, challenges arise in translating these acquired skills into effective classroom teaching due to poor infrastructure and a lack of interest among teachers in creating multimedia content. Consequently, students in these Madrasahs face limited exposure to ICT enhancements. In light of these findings, the study advocates for increased in-house teacher training initiatives and the establishment of modern computer labs equipped with essential ICT tools in every Madrasah.

Keywords: ICT, Madrasah Education, Secondary Education, Bangladesh.

Introduction

Madrasah education holds a pivotal position in Bangladesh, standing alongside General and Technical-Vocational Education as one of the three main educational streams. Evolving beyond its traditional religious focus, contemporary Madrasah curricula now incorporate a spectrum of general subjects. The government's commitment to modernize the Madrasah

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education system underscores the imperative for qualified and skilled teachers, essential for cultivating an effective teaching-learning environment. Recognizing education as a cornerstone for societal and economic advancement, the demands of the 21st century exert pressure to revitalize systems, particularly within secondary Madrasah education. Concepts like the information or knowledge society, emerging pedagogy, and 21st century skills elucidate the areas of practice and change in this context (Ottestad, 2010). Amidst these dynamics, information and communications technology (ICT) introduce a new set of challenges and imperatives. The nationwide surge in demand for Madrasah education necessitates innovative approaches from both governmental and non-governmental entities. The overarching goal is to enhance access and elevate program quality, ultimately bolstering competitiveness. Recognizing the transformative potential of ICT, all Madrasah education-related institutions are undergoing ICT training, aligning themselves with the demands of the 21st century. Recent successes, such as Madrasah students achieving commendable results in Public Universities and Medical Colleges admission tests, highlight the positive outcomes of these efforts. The global emphasis on ICT in secondary education reinforces the seriousness with which governments worldwide, including Bangladesh, are investing in their education systems. This strategic investment is not only viewed as a means to alleviate poverty but also as a mechanism to elevate the ICT skills of the populace and propel the nation towards an information society (Rahman, 2010). In the face of rapid ICT development globally, it is imperative for Bangladesh, like many other nations, to judiciously integrate and leverage ICT in the teaching-learning processes, particularly within Madrasah education. Collaborative efforts, including initiatives by BMTTI and other training programs for Madrasah teachers, play a pivotal role in equipping educators to navigate the challenges posed by the 21st century. Thus, this study is intended to investigate the overall picture of the integration of ICT in academic and administrative activities in Madrasah for quality education of Bangladesh.

Objectives of the Study

The main objective of this study was to investigate the ICT integration in academic and administrative activities in Madrasah level for quality education of Bangladesh. The specific objectives of this study were:

- to investigate the institutional readiness of ICT integration in Madrasah education at Rajbari district
- to ascertain the necessary measures to integrate ICT in both academic and administrative perspective of Madrasah education level

Rationale of the Study

In the context of Bangladesh, a developing country with a unique position as one of the few secular Muslim-majority nations globally, Madrasah education holds significant prominence alongside general and technical-vocational education. The sector boasts a substantial student and employer population, prompting governmental initiatives such as the Teaching Quality Improvement Project (TQI- I & II) funds in the ICT sector for sustainable development alongside Madrasah education. Recognizing the evolving landscape of education in the 21st century, Information and Communication Technologies (ICTs) emerge as a crucial component of the teaching toolkit, presenting new and transformative models of development (Leach, 2005). Reports indicated promising outcomes in employing ICT for Madrasah education, where innovative tools, technology integration, and interactive content have heightened student attention and interest. Despite these positive aspects, certain Madrasahs institutions may encounter challenges in navigating the transition, including addressing teaching problems, managing costs, selecting appropriate technology, and equipping staff with requisite knowledge and skills. Several studies highlight key constraints in Madrasah education, encompassing the unavailability of modern ICT tools, lack of motivation and training, and hesitancy towards integrating ICT tools into teaching-learning activities.

This study aimed to delve into the utilization of ICT by Madrasah teachers and staff in both instructional and administrative capacities. It aimed to identify the training to enhance their ICT skills, addressing the challenges in the sector. Additionally, the research endeavors to unravel attitudes toward incorporating ICT tools in teaching and administrative activities, with a focus on how such integration can serve as a facile and effective means to enhance the overall quality of Madrasah education. Through a comprehensive exploration of these dimensions, the study aspired to contribute valuable insights for the advancement and improvement of Madrasah education in the contemporary educational landscape.

Review of Related Literature

In Bangladesh, the education system is compartmentalized into three main categories: General, Madrasah, and Technical Education. Despite this division, the Madrasah education system is intricately woven into the fabric of our national education framework. The primary objective of Madrasah education is to impart Islamic knowledge, specifically focusing on Shariah education. Bangladesh hosts diverse forms of Madrasah, each serving a unique purpose: Maktab, Hafizia, Qawmi, and Alia (Obaidullah 2021). Maktab, an Arabic term denoting schools for elementary Islamic subjects, serves as the foundational institute where children learn the Quran and essential Islamic principles. Typically associated with local mosques, Maktabs are overseen by the mosque's Imam or Muazzin. Hafizia

Madrasahs, crucial Islamic education institutes in Bangladesh, specialize in memorizing the entire Quran and imparting fundamental Islamic knowledge.

However, the Madrasah Education System in Bangladesh represents a distinctive approach, concentrating on religious education within an immersive religious environment. Instruction is primarily conducted in Arabic, and in certain regions, students actively participate in local Masjids, reinforcing the practical application of their religious studies. This educational system comprises two main categories: the 'Qawmi' Madrasah, privately owned and aligned with the 'Deobandi' system of Islamic education, which tends to reject natural sciences; and the 'Alia' Madrasah, also privately owned but subsidized by the government. Aligned with the Islamic Deobandi model the Qawmi education system adheres to traditional Muslim education in Bangladesh, operating independently without government intervention. On the other hand, Alia Madrasahs provide education in Bengali, English, Science, Geography, and Mathematics until class 8 as compulsory subjects, with a primary focus on theological subjects. However, despite a lack of training opportunities and concerns regarding salaries, Qawmi Madrasahah remains unaffected by government rules and curriculum.

Table-1: Indicated the Total Number of Alia Madrasah in Different Division of Bangladesh

Division	Institutional Level				
	Dakhil	Alim	Fazil	Kamil	Grand Total
Barisal	818	190	140	20	1168
Chattogram	1031	285	257	69	1642
Dhaka	794	220	162	44	1220
Khulna	878	178	102	26	1184
Mymensihg	568	93	83	14	758
Rajshahi	1123	210	153	31	1517
Rangpur	1063	170	152	24	1409
Sylhet	278	66	36	16	396
Grand Total	**6553**	**1412**	**1085**	**244**	**9294**

(Source: BANBEIS-2019)

On the other hand, the Alia system, while resembling the general education system, incorporates Arabic into its curriculum. Oversight for religious education at the secondary level in government-registered Madrasahs falls under the purview of the Madrasah Education Board. Considered government Madrasahs, Alia Madrasahs adhere to government regulations and offer an integrated education system that combines religious and

general knowledge. Introduced to produce skilled graduates, the Alia Madrasa education system includes humanities and science groups. Governed by the Bangladesh Madrasah Education Board, Alia Madrasahs face challenges, including a shortage of trained teachers, stigma surrounding madrasa education, and inadequate academic reforms. Limited science facilities and stringent regulations contribute to students' reluctance to pursue science, affecting their employability.

In recent years, minimizing the identified challenges the government of Bangladesh has taken measures to advance Madrasah education system. Govt. also made considerable strides in its commitment to building a digital Bangladesh, emphasizing the integration of technology into Madrasah education. Alongside general and technical-vocational educational institutions, registered Madrasahs receive ICT equipment and training support for their teachers. Despite ongoing efforts to equip Madrasah teachers with ICT skills, persistent challenges include a lack of professional development opportunities, time constraints hindering technology learning, and an insufficient ICT infrastructure. Scholars such as Jones (2002) stress the pivotal role of teachers comprehending computer hardware and software for effective pedagogical practices, a sentiment echoed by Bitner and Bitner (2002), who advocate for a transformative shift in teaching paradigms through technology integration. In this connection, several studies highlighted the imperative need for ongoing professional development for teachers in utilizing the Internet and other technologies (Gibson & Oberg, 2004; Zakopoulos, 2005). Notably, Zhao and Frank's (2003) study suggests that teachers primarily use computers for lesson preparation and communication, indicating a potential gap in student-centered activities, such as electronic database use or Web Quests. The potential impact on student learning remains a central focus, with multiple studies (Reynolds et al., 2003; Robertson et al., 2004; Serim & Koch, 1996) suggesting improved outcomes when ICT is integrated into the classroom. The Education For All Global Monitoring Report (2013/14) underscored the potential of digital classrooms to enhance learning, especially in countries with limited resources.

In Bangladesh, the government's commitment to overcoming infrastructure challenges through National ICT Policy (2015) revisions and initiatives is evident. Notably, the Bangladesh Madrash Teachers' Training Institute (BMTTI) plays a pivotal role in providing professional development for Madrasah teachers. However, limitations persist in terms of scope, particularly in training opportunities for Islamic studies and Arabic teachers in the general stream, and those teaching subjects like Al-Quran, Tafsir, Al-Hadith, and Fiqh in Madrasahs. With the growing number of Madrasahs and students, BMTTI strives to enhance institutional efficiency through human resource development, aiming for quality teachers and education. The increasing role of technology in education, coupled with the unique

challenges faced by Madrasah teachers, underscores the importance of continual support and training to ensure a seamless integration of ICT tools in the Madrasah Education System (BANBEIS, 2016).

Methodology

This explorative study employed a combination of primary and secondary data sources, utilizing both qualitative and quantitative approaches. The entire population of Madrasahs, including teachers, students, and management authorities, was considered as population of the study. A purposive sampling strategy was employed, selecting 10 Madrasahs (1 from urban and 1 from rural areas in 5 upazillas) in Rajbari District. For primary data collection, 10 classroom teaching-learning sessions were observed purposively. Additionally, 10 students from each Madrasah (grade IX-X) were chosen for Focus Group Discussions (FGD), ensuring equal gender representation. One superintendent, five teachers, and one office staff cum Computer Operator were selected from each Madrasah. Officials including USEO/AUSEO from five upazillas in Rajbari, two ICT Personnel from Directorate of Madrasah Education, one from Madrasha Education Board & a2i, and one from BMTTI were included in the study. Primary data were collected through questionnaires, semi-structured interviews, classroom observations, and Focus Group Discussions (FGD). Prior consent was obtained from all respondents. Secondary data sources included the analysis of ICT-related documents, study reports, and a review of relevant literature. Quantitative data underwent statistical analysis, while qualitative data underwent thematic analysis. Presentation of findings involved the use of tables, charts, figures, diagrams for quantitative data, and thematic narratives for qualitative data.

Scope and Limitation of the Study

This study conducted in covid-19 pandemic time inquired into various factors influencing Madrasah education opportunities, encompassing careful planning, the role of ICT, quality education, learning outcomes, affordability, existing ICT infrastructure, resources, and an understanding of the overall situation. However, the sampling may not fully represent the entire population, potentially limiting the uncovering of the actual scenario. Methodological constraints in selecting superintendents/ assistant superintendents, teachers, staff, students, and officials were acknowledged. The study was confined to a single district in Dhaka division due to time and financial constraints. Consequently, there remains significant scope for further research on the ICT landscape in Madrasah education, extending the study nationwide.

Findings of the Study

Institutional Readiness

The study found that, the Government of Bangladesh has implemented diverse ICT training programs, including A2I, ICT Division, TQI, URICTE, and DSHE, aligning with the Vision 2021 initiative. These programs, encompassing ICT Training, Follow-Up Training, Refresher Training, Basic Teachers` Training (BTT), Trouble Shooting, ICT Digital Content, ICT/Arabic/Subject-based Training, and In-House Training for Teachers, have enabled Madrasah teachers to create digital content, contributing to the realization of Vision 2021. BMTTI primarily focuses on training superintendents/ assistant superintendents for administration, integrating ICT content. Recognizing these efforts, awards were bestowed for incorporating ICT into Madrasah education. Upazila Secondary Education Officers assess the ICT capacity during visits, ensuring each institution links with MMC Apps, obligating them to upload content on their Multi-media Class, centrally monitored, to ensure compliance. The Government of Bangladesh consistently introduces various ICT training initiatives for teachers, reflecting a commitment to ongoing development. The key findings, interpretations, analyses, and evaluations are outlined below:

Professional Training and Degrees of Superintendents (Head Teachers)

The findings (figure-1) indicates that a significant majority of Madrasah superintendents, constituting 90% of the sample, received ICT training, specifically undergoing a mandatory six-day basic teacher training at nearest Teachers' Training College, as directed by the Government of Bangladesh (GoB). This training aimed to equip superintendents with the skills to integrate ICT into education, emphasizing the importance of such training in the education sector. The remaining 10% did not undergo this training. On the contrary, the study also revealed that all superintendents (100%) lacked a professional degree (BEd and MEd). Despite recognizing the significance of professional degrees in the teaching profession, as one superintendent expressed, their Madrasha Management Committee encourages and supports teachers seeking such

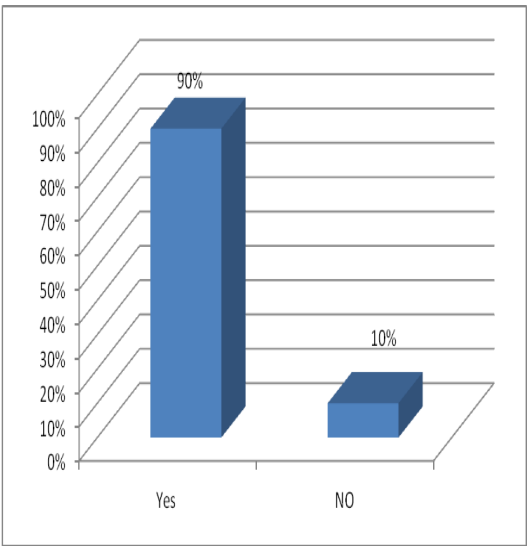

Figure 1: ICT Training of Superintendent

qualifications, emphasizing its importance in providing effective education. The superintendent stressed the value of professional degrees and noted that teachers who pursue them receive encouragement, permission, and necessary support from the committee. This underscores the importance of professional qualifications in enhancing teaching practices within the Madrasha education system. As one of the superintendents opined;

> *Professional degrees (BEd and MEd) are very much important in education sector that is highly linked to provide good deliveries. We encouraged our new teachers to admit to the courses. Teachers get an increment for the degree. Our Madrasah Management Committee is concern about it. If any teacher wants to get admission, we give them permission and provide necessary support.*

Professional Trainings and Degrees of Madrasah Teachers

The findings (figure-2) reveals that a significant majority of Madrasah teachers, comprising 85% of the sample, have undergone various ICT training programs, including ICT Training, Follow-Up Training, Refreshers Training, Basic Teachers` Training (BTT), ICT Digital Content, and ICT/Arabic/Subject-based Training. These trainings significantly enhanced their professionalism, with trained teachers actively engaging in in-house training to assist their untrained colleagues. However, 15% of teachers remained untrained, primarily older teachers and some female educators who expressed disinterest due to family issues. Notably, newly recruited teachers by the Non-Government Teachers' Registration & Certification Authority (NTRCA) demonstrated higher efficiency, actively participating in ICT training and assisting in administrative tasks.

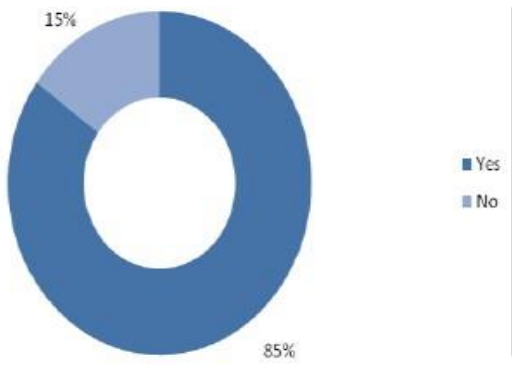

Figure 2: ICT Training of Teacher

On the other hand, figure-3 shows the professional degrees of teachers. The majority (68%) held a BEd degree, while none possessed an MEd degree. A small percentage (6%) had a BPEd degree, and 20% had

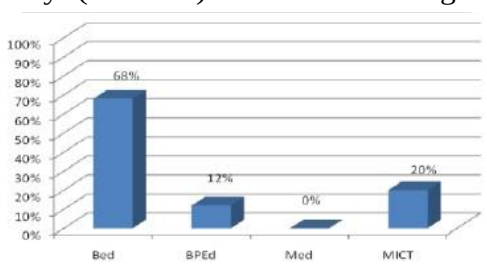

Figure 3: Professional Degrees of teachers

pursued and achieved an MICT degree from recognized institutions. Teachers with BEd or MEd degrees emphasized the importance of these qualifications on their teaching methods, enhancing class dynamics and student enjoyment. Encouragement from superiors further motivated young teachers to pursue these courses, reflecting a positive perception of the benefits of professional degrees in the teaching profession. One of the teachers expressed that

> *'BEd and or MEd are very much helpful for our professional development. It helped us to conduct a joyful class. Students enjoyed my class. Our superintendent encouraged us to admit to this course. Most of the young teachers are interested to do this course.*

Infrastructural Facilities

As per Figure 4, 60% of Madrasahs (N=6) boasted WiFi facilities, and a mere 20% (N=2) were equipped with a dedicated Computer Lab. The study also hilights the absence of alternative power supply facilities in the examined area. In accordance with government directives, it was announced that each institution would receive an ICT Lab during 'Mujib 100 Year'. Furthermore, every institution received a designated cell number and Modem from the Madrasah board, intricately linked to their EIIN number for official purposes. The data also indicates that, 90% (N=9) of the multimedia were in regular use though a few (10%) were inactive at classroom use. However, none of the Madrasahs were well decorated with ICT facilities because all the Madrasahs were situated at the Upazila level. These were the common phenomena in all the Madrasahs observed.

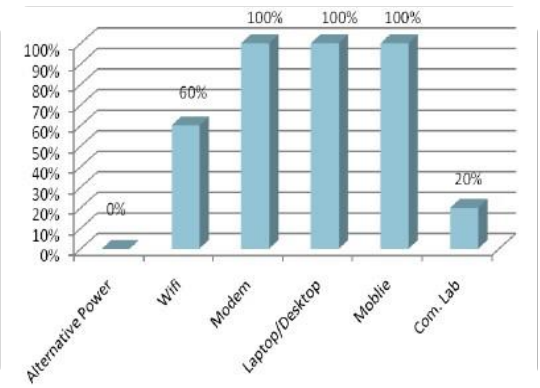

Figure 4: Infrastructural Facilities

Personal Device/Laptop Accessibility of the Teachers

Figure 5 presents that, 51% of teachers (N=24) own personal laptop/desktop devices, while 49% (N=23) rely on institutional or peer resources. Additionally, a significant number of teachers' families have laptops for shared use. Amid the current emphasis on online classes due to the pandemic, personal laptops are deemed essential for effective participation, reflecting the necessity to adapt to the educational demands of the new generation, as emphasized by a Madrasah teacher as stated '*The covid situation introduced the online class in education. The GoB and institutions also emphasized on it. If someone wants to cope with the new generation; device is must*.

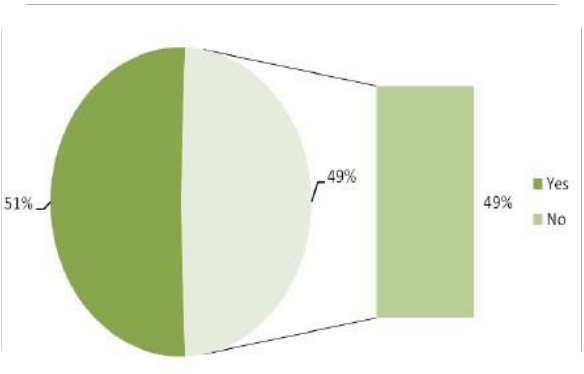

Figure 5: Personal Laptop accessibilities by teachers

On the contrary, data also represent that, some teachers were felt discourage to use ICT in teaching learning. They prefer to use traditional teaching method in the classroom. Study observed most of the aged teachers and female teachers had lack of interest in using digital content in classroom activities whereas young teachers were interested in digital content in the classroom. This may be due to device accessibility or mental readiness for change and adjustment.

Readiness and Performance of Office Assistant cum Computer Operator

According to the data, each Madrasah designated an office assistant cum computer operator responsible for relaying government orders and circulars to the superintendent. Regrettably, these operators did not undergo any ICT training from external organizations. However, a teacher, having attended official training, introduced the system to the office assistant cum computer operator. Data further disclosed that recently the Madrasah Education Board organized official training for Office Assistant, but it proved unsatisfactory across all levels. One of the Office Assistants expressed that, *I am not provided any ICT training officially before starting my job here. I use my personal skills to do the task in madrasah with the help of the teachers. I got a training recently but I could learn very little from it.*

Integration of ICT Capabilities as Necessary Measures to Accessibility in Shikkhok Batayon

As per data, being a member of Shikkhok Batayon (a platform for multi-media content) is now mandatory for all teachers. However figure-6 shows that, 68% (N=32) teachers are currently enrolled, while the remaining 32% plan to join. There is an ongoing initiative to have 9 lakh teachers become Sikkhok Batayon members by 2021, encompassing the entire teaching community. As of July 18, 2020, Shikkok Batayon boasts a total membership of 428,821, offering 953 model contents and 291,738 regular content. This platform serves as a highly beneficial and effective resource for teachers of all backgrounds, providing readily accessible content for classroom use.

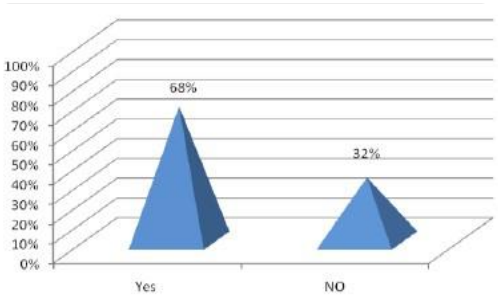

Figure 6: Member of Shikkhok Batayon

Content Availability for Madrasah Education

According to the number of the contents available in Shikkhok Batayon, the analysis of the scenario revealed a notable discrepancy in the integration of ICT in Madrasah education compared to general education.

Table 2: Comparison between the content availability of Madrasah and General Education

SL	Subject	Madrasa Education	General Education
01	ICT	838	5326
02	Physics	39	499
03	Chemistry	22	540
04	Biology	62	604
05	Higher Math	4	154
06	Economics 1	9	153
07	Economics 2	1	58
08	Islamic History & Culture 1	2	74
09	Islamic History & Culture 2	6	75
10	Civics & Good governance 1	6	94
11	Civics & Good governance 2	5	85
	Total :	**994**	**7662**

Source: Shikkhok Batayon, 2020

While Madrasah education has made efforts to incorporate ICT, the numbers fall behind those of general education, as indicated in Table 2. In the context of ICT, Madrasah education shows a count of 838 contents, whereas general education has 5326 contents. Similarly, in subjects like Physics, Chemistry, Biology, Higher Math, Economics, Islamic History & Culture, and Civics & Good Governance, Madrasah education lags significantly behind general education in terms of content availability. For instance, in Physics, Madrasah education has 39 contents compared to 499 in general education. This discrepancy suggests a notable gap in the utilization of ICT resources between Madrasah and general education, highlighting the need for further emphasis on incorporating ICT into Madrasah education to align with broader educational trends.

Accessibility in Muktopaath

Data represents that, Muktopaath is an online platform for the professional development of the teachers and other officials. Given Muktopaath's popularity for online ICT courses among teachers and students, the government stresses the need to increase its membership. Figure-7 shows that 62% (N=30) of teachers are currently Muktopaath members, while the remaining 38% plan to join. The study observed the platform's accessibility, allowing teachers to visit at their convenience. With 162 courses covering various ICT-related topics, Muktopaath serves as a valuable resource for those seeking to enhance their ICT knowledge, particularly those with minimal prior understanding. As witnessed on May 3, 2020, Muktopaath boasts a total learner membership of 648,734, offering a diverse range of 68 courses.

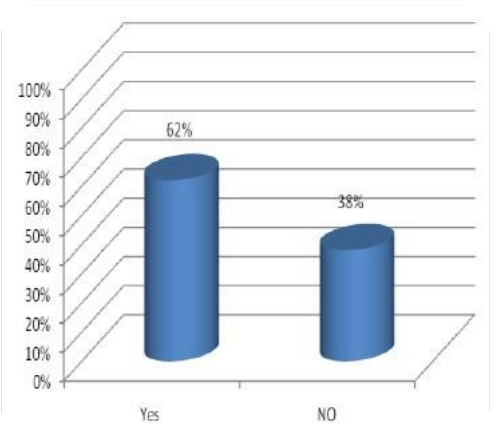

Figure 7: Member of Muktopaath

Students' Perception toward ICT Usage at Madrasah

The study's FGD data indicates limited student access to ICT equipment in Madrasahs' Computer/ICT Labs. A few classes utilize multimedia content, primarily in ICT classes, and the use of PowerPoint presentations by teachers is infrequent. A student emphasized the scarcity of ICT lab access, occasional use of PowerPoint in ICT classes, and minimal exposure to ICT tools. As one of the students stated that,

> *We don't get access to our ICT lab. Sometimes ICT classes are conducted using power-point slide. However, this practice is very limited for other subjects. Even we rarely get opportunity to use ICT equipment meanwhile our registration process (e.g. form fill up) for Dakhil & Alim Examination is also proceeded by madrasah authority.*

Perspectives of the Higher Authority

According to the Higher Authority of Madrasah Education, data show that with the government's heightened emphasis on ICT-based education across all levels, Madrasah education is receiving increased attention. Government orders underscored the imperative of digitizing Madrasa education and administration processes. Madrasahs are mandated to enroll their teachers in online learning platforms like Muktopaath, and teachers are encouraged to join Sikkhok Batayaon for multimedia content exchange. The government, through the a2i project, has established 35,000 Multimedia Classrooms (MMCs) for both general and Madrasah education. Additionally, the government conducts various training sessions and workshops for Madrasah teachers and staff. Notably, the government is initiating the creation of individual websites for every Madrasah, marking a significant step forward. A high-ranking government official highlighted that,

> *Government announced that every institution will get an ICT Lab in Mujib Year. Every institution got a mobile number and Modem from Madrasha board. This cell number is linked with their EIIN number. It is used for official and other purpose. All kinds of orders and instructions are provided through mobile number. It is also used for government payment.*

Discussion

The study highlighted on the current state of ICT integration in Madrasah Education, revealing several noteworthy findings. Firstly, the strong association between the ICT subject and Multimedia Classrooms (MMCs) underscored the pivotal role of technology in instructional practices. Particularly, ICT teachers' exhibit heightened engagement in Power-Point Presentation, highlighting the subject's dynamic nature. A noteworthy trend emerged concerning teacher demographics: while young educators express enthusiasm for incorporating digital content into classroom practices, a significant proportion of aged and female teachers exhibit a lack of interest. This discrepancy suggests a potential generational and gender divide in the willingness to embrace ICT tools for teaching.

Despite challenges, all ICT teachers in Madrasah possess foundational ICT training, emphasizing a positive step toward equipping educators with

essential skills. However, the study also unveiled a stark reality regarding the limited ICT facilities and infrastructure in Madrasah, with the majority having fewer than five active desktops. The absence of internet connections in classrooms further accentuates the digital divide.

The critical observations and challenges identified in ICT practices in Madrasah include inactive Multimedia Classrooms (MMCs), a lack of alternative power supply, absence of modern computer labs, poor student access to ICT equipment, and inadequate monitoring mechanisms. These challenges underscore the urgent need for comprehensive reforms to enhance ICT infrastructure, teacher training, and overall implementation strategies in Madrasah Education. Addressing these issues is crucial for ensuring equitable access to quality education and fostering a technologically inclusive learning environment in Madrasah education.

Recommendations

Based on the findings and discussion, the study suggests the following recommendations:

- Activating and maintaining Multimedia Classrooms (MMCs) in Madrasahs, ensuring regular updates and utilization for effective teaching and learning.
- Creating well-equipped and modern computer labs in Madrasahs, enhancing the overall ICT infrastructure for both teachers and students.
- Developing strategies to improve student access to ICT equipment, ensuring their active participation in digital learning activities.
- Prioritizing the installation of internet connections in classrooms to facilitate online learning, research, and communication.
- Implementing alternative power solutions, such as solar power, to counteract the lack of consistent electricity, ensuring uninterrupted ICT practices.
- Developing specialized ICT training programs tailored to the needs of aged and female teachers, addressing their specific challenges and enhancing their digital skills.
- Implementing incentive programs to recognize and reward teachers who actively engage in ICT practices, fostering a culture of innovation.
- Establishing a regular monitoring system to assess the functionality of ICT facilities, identifying and addressing issues promptly for sustained effectiveness.

- Fostering collaboration between government bodies, educational institutions, and private sector organizations to collectively address challenges and implement sustainable solutions for advancing ICT in Madrasah Education

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The title of the article should contain the title of the article and suggestions for a short running title of not more than 90 characters (including spaces). Title should not be in statement form. Also the manuscript should include the authors' names, affiliations and contact details (including e-mail address) for the corresponding author.

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Authors are requested to submit an unstructured abstract of not more than 250 words. Abstract should be informative for non-specialists.
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Unterhalter (2007, p. 5) argues that 'gender equality in schooling is an aspiration of global social justice'.

Personal communications should be listed as such where they are cited in the text, and not listed in the references.

Example:
Results have been reported (Don Graham, 1989, personal communication). Articles not yet published should show 'forthcoming' in place of the year (in both the reference and the citation). 'In press' should be used in place of the volume, issue and page range details.

Example
Sharp Parker, A. M. (forthcoming) Cyberterrorism: An examination of the preparedness of the North Carolina local law enforcement. Security Journal, in press.

References

References should be placed alphabetically by author or authorship, regardless of the format, i.e. whether books, websites or journal articles etc.

Examples of Correct Forms of References:

Book

Slovic, P. (2000) *The Perception of Risk*, Earthscan Publications, London.

Edited Volume

Nye Jr, J.S., Zelikow, P.D. and King D.C. (eds.) (1997) *Why People Don't Trust Government*. MA: Harvard University Press, Cambridge.

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Papers/Talks Presented at a Conference but Not Published

Danaher, P., Danaher, G. & Moriarty, B. (2006) 'Supervising Australian and international postgraduate students', paper presented to the Lifelong Learning Conference, Yeppoon, June.

Dissertation/Thesis (Unpublished)

Wagner, S. J. (2004) Derailment risk assessment, Masters thesis, Central Queensland University, Rockhampton.

Figures and Tables

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