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CASCADING IMPACTS OF MULTI-DAM BREAK SCENARIOS USING 2D HEC-RAS FLOOD MODELING

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Abstract: *Two-dimensional (2D) hydraulic modelling technique for flood setting extraction is important for simulating dam breach hydrodynamics, predicting dam failure and for flood mitigation measures. Dam break hydraulic flood models can be created using LiDAR-derived digital elevation models (DEMs) and then processed in dedicated geographic information systems (GIS) tools. Hydraulic modelling can greatly enhance flood hazard maps in the occurrence of potential dam failure. In this study, River Analysis System (HEC-RAS) tool was utilised as a hydraulic modelling technique to predict the rise in the water level of the main reservoir. During the process, flood routing was simulated to predict the breach parameter, breach outflow hydrograph and the estimation of the flood inundation area. The study area is about 2,600* km^2 *surface area, holding 23.6 million* m^3 *of water, located in the catchment on the east coast of Peninsular Malaysia. The study area consists of two (2) dams impound two (2) upstream reservoirs at the upper catchment. The main reservoir is located downstream of these two (2) dams. Simulated results showed that the main reservoir's water level rose significantly due to the failure of the upstream dams during the Probable Maximum Flood (PMF) event. The highest water level value reached at the main reservoir under the cascading effects of PMF failure by both upstream dams is 6.68m. This cascading impact will have a critical consequence on the main dam if the initial lake level is at EL 148m, which would cause the main dam to overtop and dam failure to occur. The findings from this study can significantly help dam owners and respected agencies develop emergency management plans, minimising the dam break risk to the affected population downstream. Since the dam failure poses a disastrous impact on people downstream, thus, the findings can greatly help dam owners and respected agencies develop emergency management planning to minimise the risk to the affected population downstream.*

Keywords: *Reservoir, Dam Probable Maximum Flood Failure, Cascading Impact*

Introduction

A flood event is a massive natural disaster with many catastrophic consequences in different regions. The most common natural disaster on Earth causes loss of life and property damage (Wilfried B.M., 2017). There have been several cases of floods that have occurred due to dam failure. Dam failure is one of the catastrophic disasters that can occur for many causes, including piping through the structure, overtopping, design mistakes, significant rainfall-induced runoff, earthquakes, and others. According to the Dam Safety Management Center of

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the Ministry of Water Resources of the People's Republic of China (DSMC, 2021), 3,541 dam collapse cases were documented on the Chinese mainland from January 1954 to December 2020, with 94.1% of them being embankment dam failures (Qiming Zhong a et al., 2021). In addition, many nations throughout the world currently have a huge number of reservoir dams, and have resulted in significant loss of life as a result of dam failure, as shown in **Table 1** (Xiao Fu et. al., 2018; Wishart, 2007; Sharma, 2013).

Table 1: Dam Failure Cases in the World

Dam Name	Country	Year of Accident	Dam Type	Reservoir Volume (x 10^6 m^3)	Deaths
Mohne Dam	Germany	1943	Gravity Dam	134.0	1200
Malpasset Dam	France	1959	Arch Dam	15.0	421
Vaiont Dam	Italy	1963	Arch Dam	169.0	2000
Buffalo Creek Dam	USA	1972	Tailings Dam	49.8	125
Machhu II Dam	India	1979	Earth Dam	101.0	3000
Shakidor Dam	Pakistan	2005	Earth-rock Dam	-	135
Situ Gantung Dam	Indonesia	2009	Earth-rock Dam	2.0	100

Flood events have been the most frequent natural disasters in Malaysia, posing a threat to the human population in affected areas. However, major flood events in Malaysia were due to the overwhelming rainfall that led to flash floods in the main city. Hence, proper initiatives, such as emergency preparedness plans, must be established in order to counteract the devastating consequences of a dam-break flood event on the human population, assets, and others. This paper will address the cascading effects on the main reservoir based on the possible failure scenarios of the upstream dams, namely Dam A and Dam B, by developing the dam break model using IFSAR data and related hydrology data in the HEC-RAS tool. Findings from breach parameter assessment of the upstream dams and breach hydrograph could be useful information for the development of an emergency response plan module and disaster management plan.

Study Area

Dam A and Dam B are the upstream dams that will carry the outflow discharge from the upstream catchment to the main reservoir with a total of 36,900 ha via the existing rivers. Both dams' lakes covered an area of approximately 7,189 ha or one-sixth of the main reservoir. The distance from Dam A and Dam B to the main reservoir is about 3 km and 11 km, respectively, as in **Figure 1**, while the schematic diagram for the cascading dams is shown in **Figure 2**. The general details of both of upstream dams are as in

Table 2:

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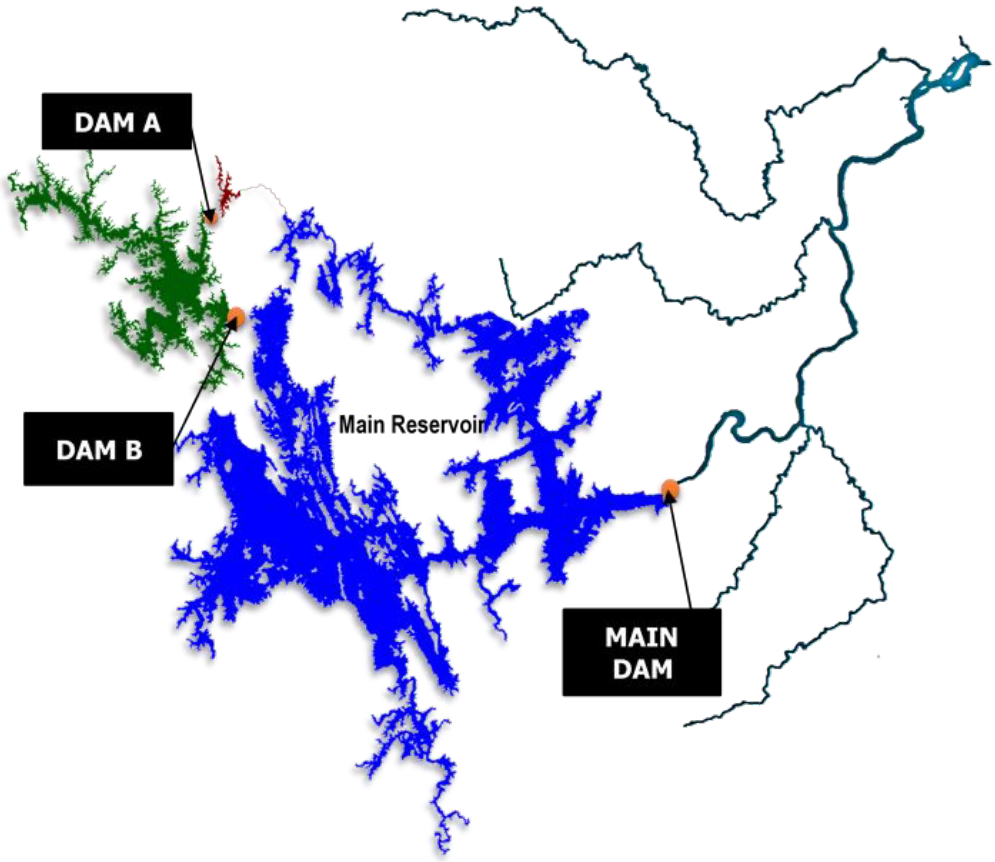

Figure 1: Location of the Upstream Dam A and Dam B

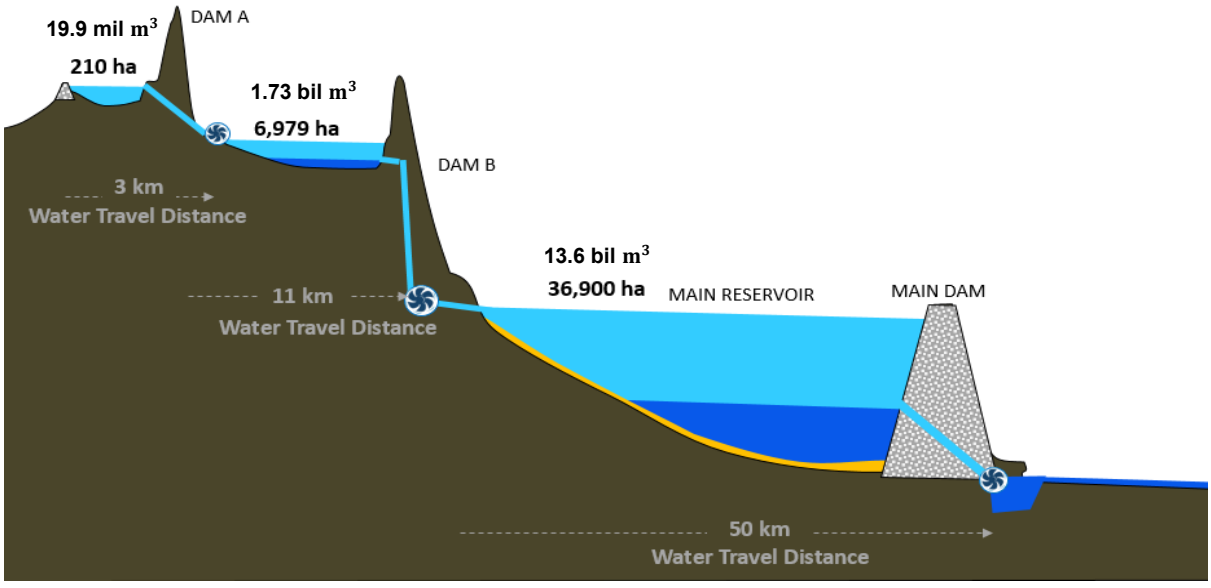

Figure 2: The Schematic Diagram for Cascading Upstream Dam A and Dam B

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Table 2: General Details of Dam A and Dam B

	Dam A	Dam B
Dam Type	Roller-compacted concrete dam	Earthfill with central impervious core
Crest Level (m)	EL 436.9	EL 299
Crest Length (m)	255	630
Height (m)	36.9	78
Catchment Area (ha)	210	6,979
Full Supply Level or FSL (m)	EL 430	EL 296
Storage at FSL (m^3)	19.9 mil	1.73bil

Cascading Dam Failure

Small dams are frequently built in a cascade along streams, which increases the risk of downstream dam failure if the uppermost dam fails (R˘íha, 2020). The dam-break flood that results when dams in a cascade breach depend on several variables, including the rate of the upper dam's breaching, the ratio of the volumes of the reservoirs in the cascade, and the lower reservoirs' capacity to attenuate the flood wave. Other significant variables include the nature of the floodplain and the separation between various reservoirs. As a result, the dam-break flood routing through a series of reservoirs in a cascade may change depending on the breaching mechanism of the uppermost dam and the available free volume and current water level in each reservoir.

Cascading Dam Failure Mechanisms

Various mechanisms have been implemented in previous studies to predict the failure impacts of the cascaded dams into the reservoirs (including reference to previous studies). A numerical simulation of a dam failure caused by a cascade of overtopping that involves modelling flood propagation in 1D flow open channels has also been developed (ZhiPing, 2019). Apart from 1D model, the previous study has also utilised Bayesian networks to analyse the risk factors and potential failure paths for breaching cascade dams, which is essential for calculating the flood risks associated with dam structures (Cai, 2019). This mechanism was simulated using Dam Breach Analysis Model (DB-IWHR) 2014. The Flume Experiment on cascading collapse of two landslide dams was carried out by Takayama (2020) under various upstream dam heights, downstream dam heights, and initial downstream reservoir water volumes. The study's findings had highlighted the key variables influencing the maximum flood flow brought on by a cascading failure. Results have also been used to–simulate models for overtopping flow-induced landslide dam destruction.

Methodology

There were several types of dam failures, for instance, overtopping failure, piping, seepage or internal erosion failure, embankment instability slides and others (Vasilis Bellos, 2020). Thus, in order to indicate the cascading impacts of Dam A and Dam B failure, it was set under overtopping failure, namely Probable Maximum Flood (PMF) failure. PMF occurs under a combination of adverse hydrometeorological conditions and is defined as ‘‘the largest flood that can reasonably be expected to occur at a given site’’ and mainly driven by PMP, which is the most extreme rainfall considered in hydrologic engineering (Wardhana, 2020). The failure

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of a dam on a clear day with the water level at normal pool elevation and no rainfall is known as Clear Day Failure (CDF).

In this study, the cascading impacts on the main reservoir will be simulated under the Probable Maximum Flood (PMF) event. Thus, the prediction of upstream dams' breach parameters, such as breach dimensions, rate of breach formation, breach side slope, and others, are the fundamental setup in the dam break model (Ros, 2020). The PMF peak inflow data for Dam A and Dam B is needed as the input for the hydrodynamic model since both dams have their catchment region. The accuracy of the analysis depends on the quality of the input data. The outflow hydrograph Qmax, which arises from the failure, is the principal outcome of the dam break study to capture the maximum water level at the main reservoir. In this study, three (3) dam break scenarios have been simulated: Dam A PMF, Dam B PMF and the cascading impacts of Dam A and Dam B PMF. The general methodology for dam break simulation processes is shown in **Figure 3**:

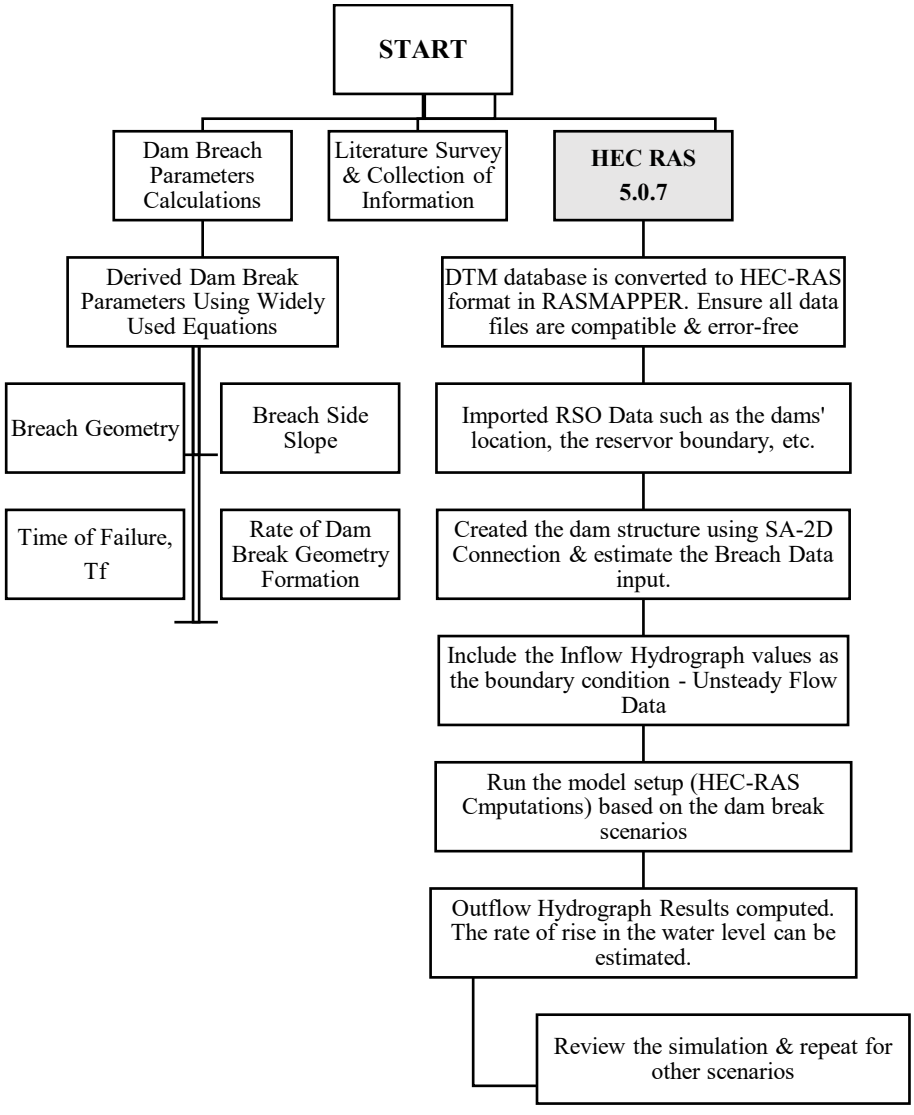

Figure 3: General Model Setup

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Data Collection

Hydrological Data

The quality of the input data used in the model significantly impacts the analysis. Information about dams and reservoirs is significant to offer fundamental physical data, such as the upstream dams' structural dimensions, maximum operating level, and storage-elevation curve of the main reservoir. As for the hydrological part, the Probable Maximum Flood (PMF) inflow hydrograph of both upstream dams based on the historical data was injected, as described in **Figure 4**. These inflow hydrographs were generated based on the tabulated historical rainfall data and served as the lateral inflow, used as internal boundary condition input in dam break model development. Lateral inflow is an option to introduce flow at a specific location along the stream, usually located upstream. Routing the inflow via the reservoir's outlets, spillways, and storage areas will yield the estimation of the storage levels, dam discharges, and other factors that will define how the flood will move through the reservoir.

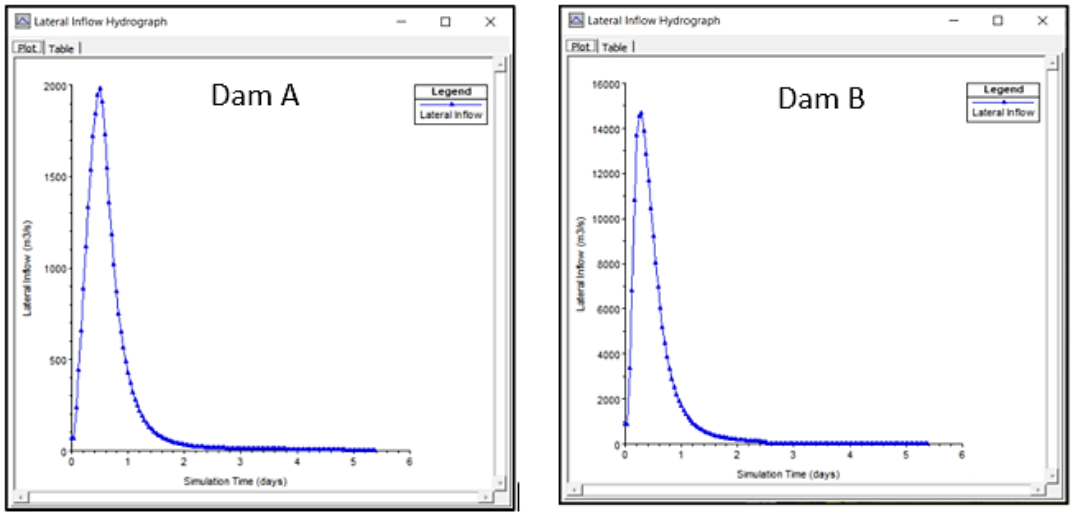

Figure 4: Dam A and Dam B PMF Inflow Hydrograph Generated in HEC RAS

Data Terrain Model (DTM)

In order to provide a spatial location and to assign a roughness coefficient for the floodplain area, topography and land use information are crucial inputs for inundation mapping. The resolution of the Data Terrain Model (DTM) to be incorporated in the model is important for the analysis. This study applied Interferometric Synthetic Aperture Radar (IFSAR) data as the base map with the elevation of 5-m spatial resolution. RAS Geometry and RAS MAPPER were used to visualise data, which includes hill shade and contours, as in **Figure 5**.

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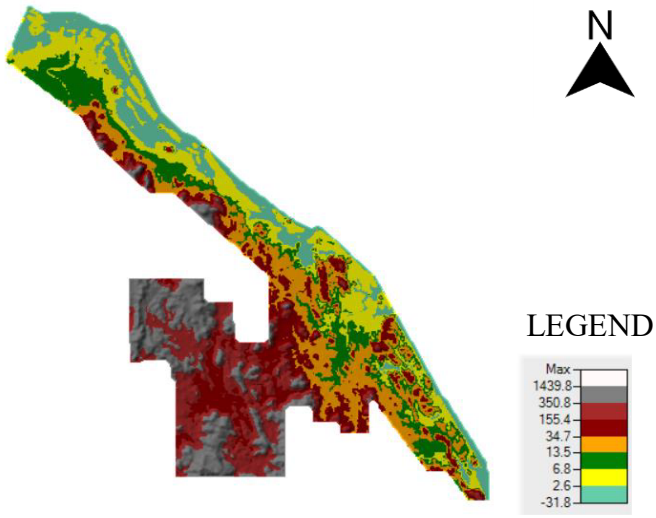

Figure 5: Screenshot of the IFSAR Data used in the RAS Geometry

Breach Parameters Estimation and Failure Scenarios

Previous research has revealed that overtopping was responsible for 34% of dam breach incidents (across all dam types), foundation failure for 30%, and other reasons for the remaining 34% in simulating dam breach hydrodynamics. Hence the study suggested a simplified dam breach model in a trapezoidal shape (Brunner, 2014). In order to make reliable predictions of peak discharge and outflow hydrographs, it is necessary to estimate the breach dimension and location, failure type, and failure time. Based on the previous studies, there were regression equations to determine breach parameters such as breach width, breach development time, and side slope based on historical data, as in **Figure 6.** Many dam breach estimations used Froehlich, MacDonald, and Langridge-Monopolis (MLM) and Von Thun and Gillete (VTG) empirical equations, as mentioned by Saad Sh. Sammen (2017).

PMF failure event will be the main scenario to be simulated in this study. Three scenarios were simulated under PMF failure; (i) Dam A PMF Failure, (ii) Dam B PMF Failure, and (iii) Dam A and Dam B PMF Failure. The scenarios were assessed for overtopping failure, whereby an uncontrolled water flow exceeds the crest level of the dams. The flow is identical to that of a broad-crested weir, where initial erosion could occur at the dam's bottom downstream section as it approaches the crest level, causing the reservoir to breach.

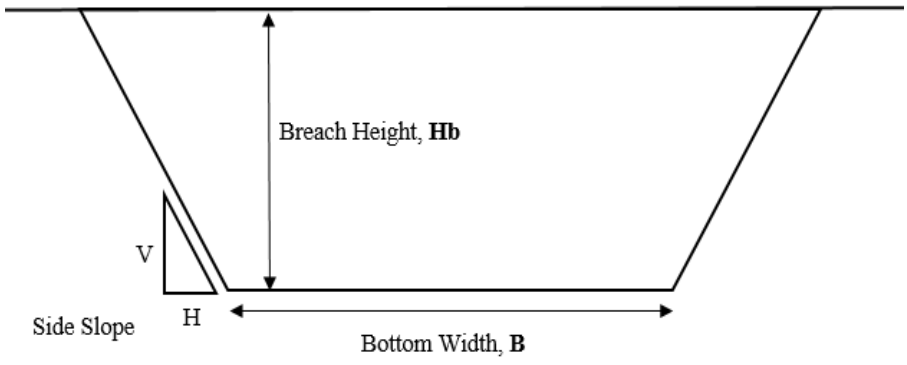

Figure 6: Dam Breach Parameters Dimension

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1-D and 2-D Simulation Model

One approach that works for the dam break scenario is the River Analysis System (HEC-RAS) from the Hydrologic Engineering Center, which is capable of both 1-D and 2-D modelling. The digitisation of geometric data for the dam break model in HEC-RAS consists mainly of the river network, river banks, reservoirs, structures, and flow area. The upstream dams are connected to their first cross-section of the river line. They are modelled using an inline structure, given that both upstream dams' sizes are insufficient to withstand the hydraulic effects due to the PMF inflow, especially during a heavy storm.

The basic geometric information for a 1-D model consists of the river reach, bank line, flow channel line, inline structure, and storage area. Then, using interpolation techniques between the actual cross sections, a number of cross sections are drawn down the downstream channel to the main reservoir. Models of the reservoir were used to represent the storage area with a storage-elevation curve. Since it is anticipated that the reservoir level will be horizontal during the drawdown, the level pool routing method is utilised to simulate the breach between the reservoir and the breach location. Manning's n coefficient of 0.035 for channel roughness and 0.16 for the overbank floodplain are both defined.

For the 2-D model, a 2D flow area polygon is created around the affected downstream area as a result of the dam break event, extending further downstream to the main reservoir. In order to delineate the spatial data and surface roughness within the flow area, DTM data was geo-referenced and exported to GIS. Manning's n coefficient values were assigned to define the surface roughness based on land use type. **Figure 7** depicts the combination of 1-D and 2-D geometry models of both upstream dams to the main reservoir created in HEC RAS.

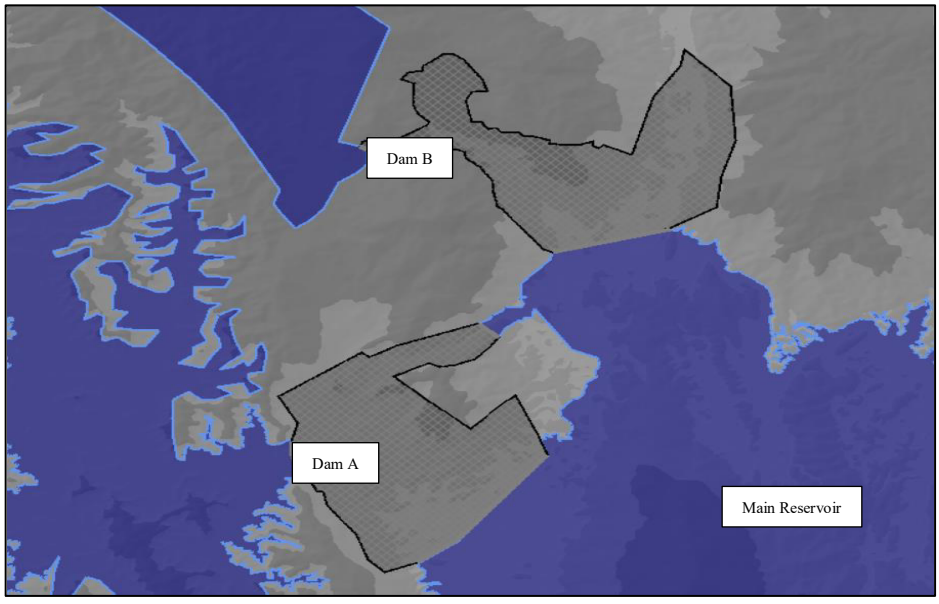

Figure 7: 1-D and 2-D Geometry Model in HEC-RAS

In 1-D and 2-D models, boundary conditions are required to specify both upstream and downstream. Storage is defined at upstream boundary conditions as inflow into the reservoir and PMF inflow hydrograph for an overtopping scenario. Normal depth is employed for the downstream boundary condition at a frictional slope of 0.05. In unsteady flow simulation, initial conditions must also be defined in addition to boundary conditions.

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The initial value of the upstream flow of the reach and initial reservoir elevation are required before executing the simulation. Before running the simulation, the upstream flow of the reach and the initial reservoir elevation were determined. The dam break simulation was computed over 24 hours. The results were displayed as a breach hydrograph and an inundation map. The magnitude of peak discharge was calculated using empirical equations, and the results were compared to hydrograph results.

Results and Discussion

Developing an accurate estimation of the outflow hydrographs and downstream inundation depends on the estimation of the breach dimension, side slopes, and breach formation time. The breach parameters were calculated using regression equation yields as in **Table 3**.

Table 3: Breach Parameters of Dam A and Dam B under PMF Failure

Breach Parameter	Dam A	Dam B
Breach Width (m)	120	450
Breach Height (m)	26.9	50
Side Slopes	1:1	1:1
Breach Formation Time (Hr)	1	2.7

Flood Hydrograph and Stage Hydrograph

Dam A and Dam B are subjected to unsteady flow simulations for overtopping failure under the Probable Maximum Flood (PMF) condition. Both dams were expected to breach at their crest levels, with the reservoir level at PMF. From 01-Jan-2007 to 04-Jan-2007, the HEC RAS model was simulated with a 4-days interval. The results are displayed as a breach outflow hydrograph, as in **Figure 8** to **Figure 10**. At the same time, the maximum water level at the main reservoir was determined using hydrograph data in **Figure 11**.

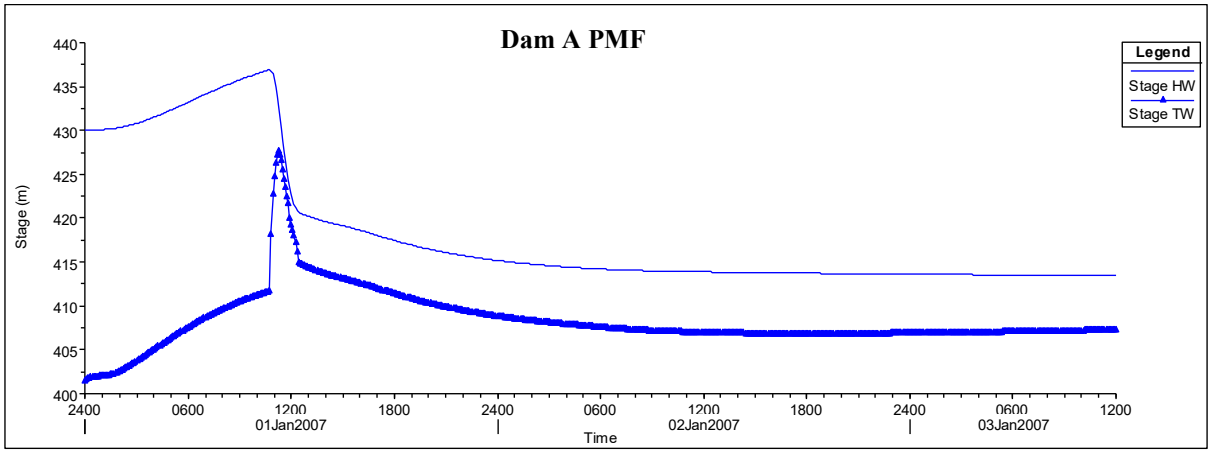

Figure 8: Outflow Hydrograph at Dam A PMF Failure

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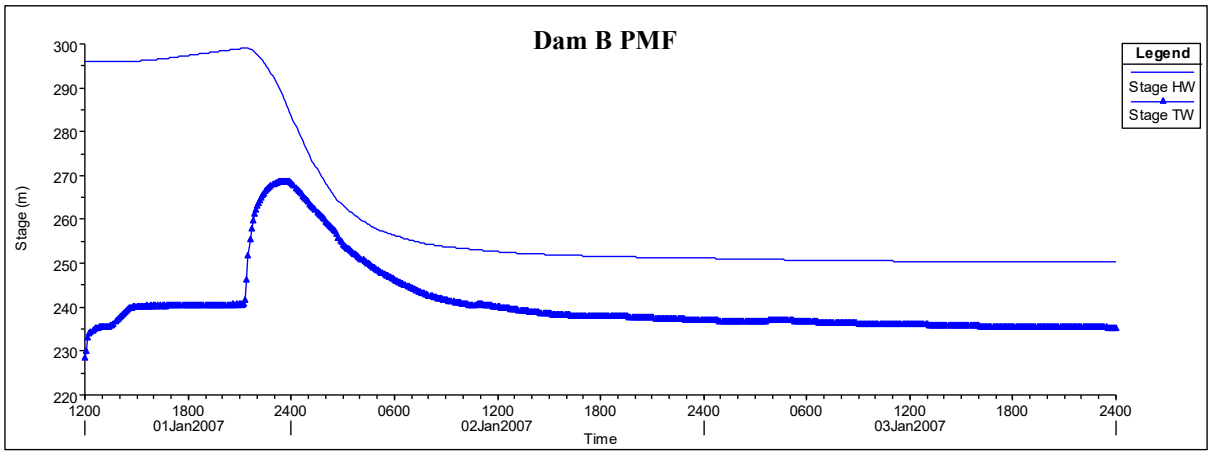

Figure 9: Outflow Hydrograph at Dam B PMF Failure

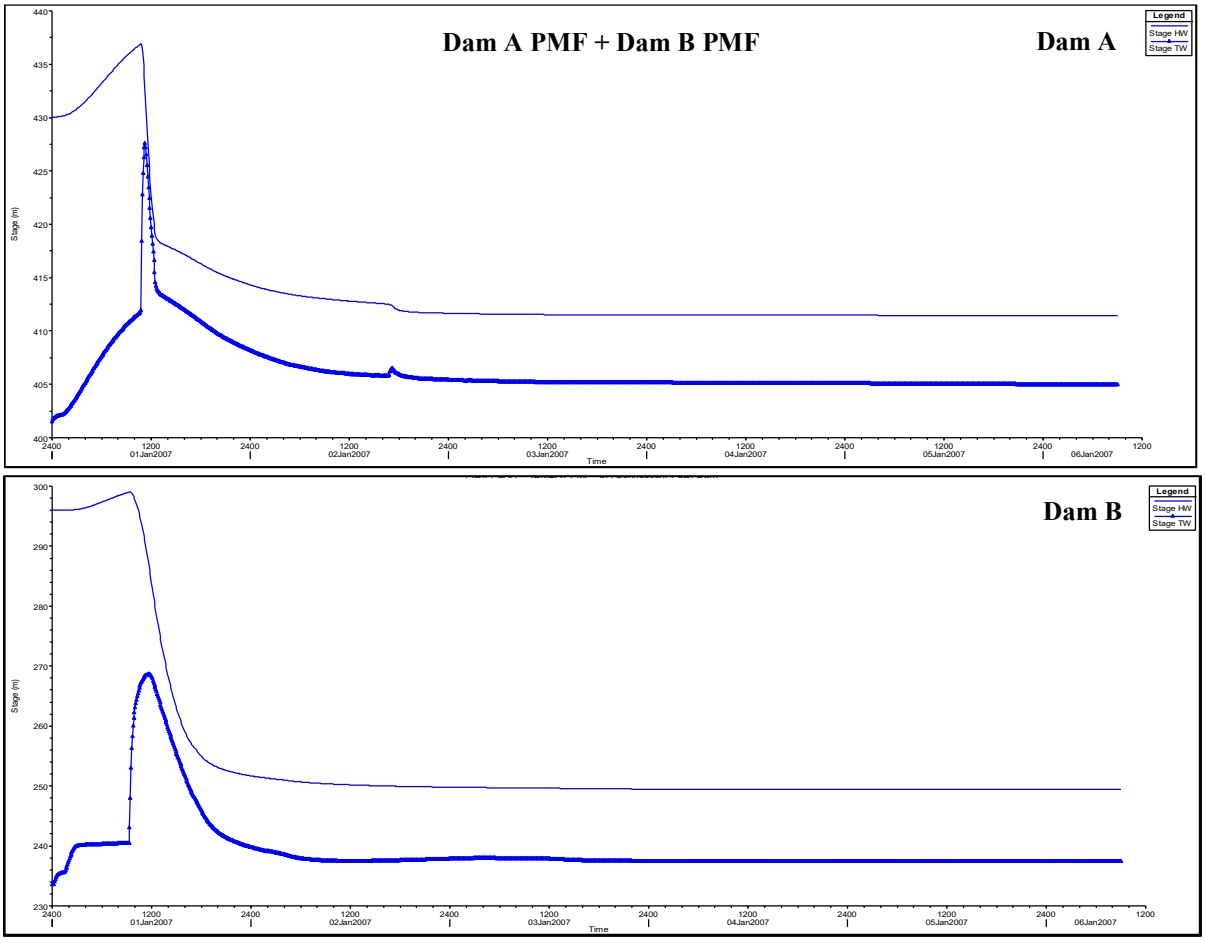

Figure 10: Outflow Hydrograph for the Cascading Effects of Dam A PMF and Dam B PMF Failure

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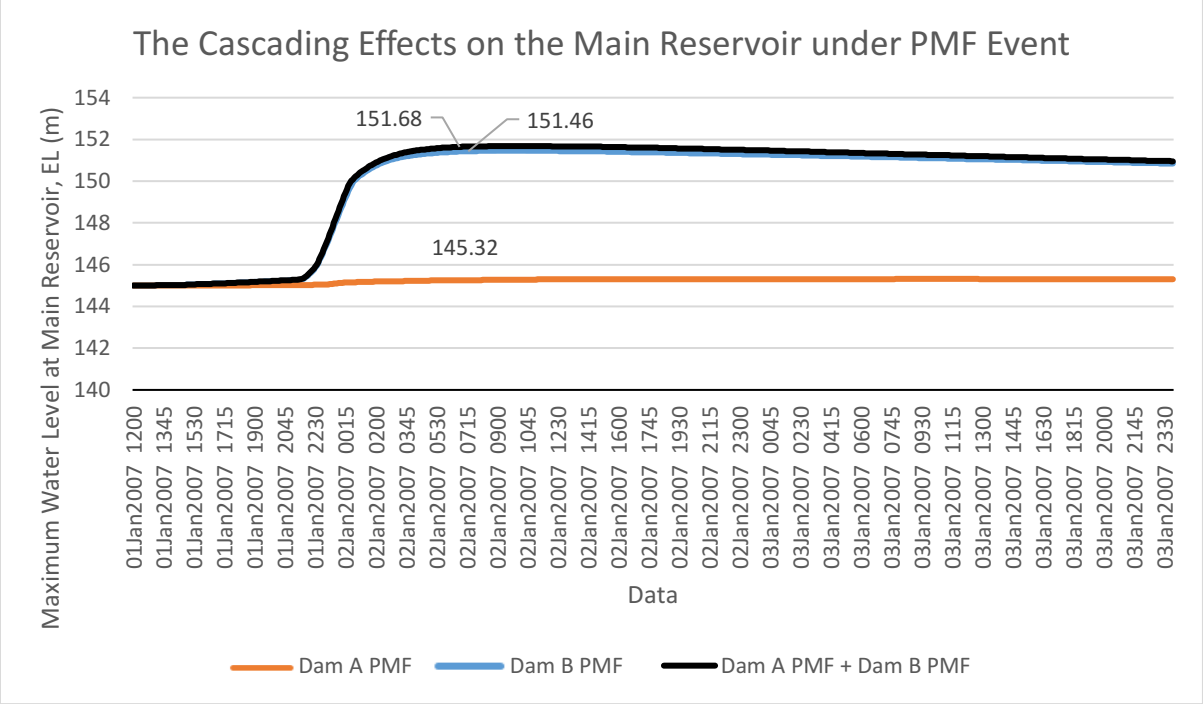

Figure 11: The Cascading Effects on the Main Reservoir under PMF Event

Table 4 represents the tabulation results extracted from the hydrograph for the maximum breach outflow and the maximum water level at the main reservoir for the three (3) dam break scenarios. The maximum breach outflow for Dam A PMF and Dam B PMF are 146,651 m^3/s and 12,582.92 m^3/s consecutively. Scenario 1, the maximum water level at the main reservoir is at EL 151.46 m with an increment of 6.46 m. The recorded water level is higher than Scenario 2, in which the maximum water level achieved at the main reservoir is about 145.32 m with only 0.32 m rise. The highest value for the maximum water level reached by the main reservoir is at EL 151.68 m under the cascading effects of Dam A PMF failure and Dam B PMF Failure, with 6.68 m rise from the initial water level at EL 145.0 m. The maximum peak discharge under Scenario 3 is about 159,230 m^3/s from both upstream dams.

Table 4: Results Comparison of the Three (3) Dam Failure Scenarios under PMF Event

Scenario	**2**	**1**	**3**
	Dam A PMF	**Dam B PMF**	**Dam A PMF + Dam B PMF**
Peak Discharge of Dam Breach, Q (m^3/s)	12,582.92	146,651	159,230
Initial Reservoir Level at **Main Reservoir** (EL, m)		145.0	
Maximum Water Level at **Main Reservoir** (EL, m)	145.32	151.46	151.68
Rise of Water Level at **Main Reservoir** (EL, m)	0.32	6.46	6.68

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Cascading Effects of Dam Failure on the Main Reservoir

In this study, the initial water level at the upstream lakes could have a considerable impact on the cascade breaching outflow rate through overlapping effects. Still, it did not affect the breaching process of a single dam. Thus, a simulated situation with appropriate initial water levels was hypothesised to produce the ideal overlapping flood (with maximal peak outflow rate). In order to determine the impact on the main reservoir, three (3) dam break scenarios were developed, as shown in **Table 4**.

In Scenario 1, the initial water level in the main reservoir was set at the elevation of EL 145.0 m. The result shows that the water depths were increased by about 0.1 m from the initial lake level at Dam A due to the peak inflow injected into the lake. Dam A first breached with a peak outflow rate of 12,582.92 m^3/s under PMF event. The breaching flood from Dam A then cascades into the main reservoir, caused increasing in water level to 0.32 m from EL 145.0 m to 145.32 m.

In Scenario 2, the initial water level at the main reservoir was also set to its normal level at EL 145.0 m. The procedure for this scenario is similar to Scenario 1, with the difference in the catchment area covered by Dam B being larger than Dam A, with a catchment area of 6,979 ha. The injection of peak inflow to the lake impounded by Dam B under PMF event has led to Dam B breaching with the maximum outflow discharge of 146,651 m^3/s. The result indicates that the water level of the main reservoir increases by about 6.46 m from its initial level to EL 151.46 m.

In Scenario 3, Dam A and Dam B were set to breach simultaneously under PMF event, in which the flood capacity is bigger than Scenario 1 and Scenario 2. The breaching sequence of the two upstream dams were maintained similar. In this case, the peak outflow from both upstream dams combined will be 159,230 m^3/s. The breaching of the two dams caused the flood to cascade into the main reservoir, thus increasing the water level from EL 145.0 m to EL 151.68 m, with an increment of 6.68 m due to the combination of the flood capacity cascaded from the two upstream dams.

Based on these three scenarios, it is observed that Scenario 3 has an enormous cascading impact on the water level of the main reservoir, compared to Scenario 1 and Scenario 2, with 6.68 m increase in water depth.

Conclusion

Dam failure could result in an outburst of water flow, which could induce more dam failures downstream, a massive flash flood, and significant damage downstream. When a multi-peak flood occurs, the former peak flood (typically with a lower peak discharge) significantly impacts the risks of the subsequent peak flood (normally with a larger peak discharge). The subsequent surprise attack of the peak flood may result in catastrophic loss to the returned people, which may be even greater than in the overlapped-peak flood situation.

In order to understand the mechanics of the dam breach, the dam break model is simulated under unsteady flow conditions utilising PMF as flow data for overtopping failure modes. HEC-RAS tool aids in simulating dam failure and breach flood routing along the river's downstream section. The peak discharge of 146,651 m^3/s of Dam A PMF and 12,582.92 m^3/s of Dam B PMF caused the rise in water level at the main reservoir increases about 0.32 m and

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6.46 m, which can be considered as the critical failure mode. Since the dam failure poses a disastrous threat to people and property downstream, this study's findings can help prevent disasters by taking appropriate actions to protect people's lives and property. This research also contributes to expanding the authorities' emergency response plan and flood mitigation measures.

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RAINBOW SOLSTICE: BREAKING THE SILENCE OF THE GLASS

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Abstract: *People around the world face violence and inequality—and sometimes torture, even execution—because of who they love, how they look, or who they are. Sexual orientation and gender identity are integral aspects of our selves and should never lead to discrimination or abuse (Reuters, 2013).* ***The*** *study aimed to determine the lived experiences of the LGBT members in the City of San Fernando, La Union. Specifically, it sought to answer the following objectives: the lived experiences based on factors of the LGBTQ++ in the vicinity, the meanings extracted from the themes and their coping mechanisms. The qualitative research method was used in this study through phenomenological approach. As a result, Despite the sexual orientation and gender identity of the members of the LGBTQ++ in the vicinity, it is of this moment that they embrace their lived experiences and consider their major contributions in the community. From their metamorphic transformation shattered by atrocious experiences and stigmas, still, they broke the silence and casted a shadow of strong empowerment proving their worth and leading the community towards gender equality, free from violence social milieu, friendly relations, full-respect, safe spaces and total social acceptance and recognition. The different factors affecting them indeed, were the true colors in the limelight, flaunting the image of a rainbow solstice full of hopes, dreams and contentment, that in this world, every individual is worth loving for.*

Keywords: *Lived Experiences, Rainbow Solstice, Coping Mechanisms*

Introduction

People around the world face violence and inequality—and sometimes torture, even execution—because of who they love, how they look, or who they are. Sexual orientation and gender identity are integral aspects of our selves and should never lead to discrimination or abuse. Human Rights Watch works for lesbian, gay, bisexual, and transgender peoples' rights, and with activists representing a multiplicity of identities and issues. We document and expose abuses based on sexual orientation and gender identity worldwide, including torture, killing and executions, arrests under unjust laws, unequal treatment, censorship, medical abuses, discrimination in health and jobs and housing, domestic violence, abuses against children, and denial of family rights and recognition. We advocate for laws and policies that will protect everyone's dignity. We work for a world where all people can enjoy their rights fully (Reuters, 2013).

In too many countries, being lesbian, gay, bisexual, transgender or intersex (LGBTI) means living with daily discrimination. This discrimination could be based on your sexual orientation (who you're attracted to); gender identity (how you define yourself, irrespective of your biological sex), gender expression (how you express your gender through your clothing, hair or make-up), or sex characteristics (for example, your genitals, chromosomes, reproductive

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organs, or hormone levels.) From name-calling and bullying, to being denied a job or appropriate healthcare, the range of unequal treatment faced is extensive and damaging. It can also be life-threatening (https://www.amnesty.org.ph/campaigns/lgbti-rights).

The presence of the LGBT is recognized, but their acceptance in the society is still vague. For decades, the LGBT in the Philippines want was to be respected and be treated equally and these LGBTs continued to fight for the passing of laws that will protect their rights as individuals (IGLHRC, 2013).

Self-actualization within the LGBT community involves an integration of the various aspects of themselves. It means they know who they are and they know their place in society. Coming out and knowing your place in society then is the way to achieve self-actualization (Anderson, 2019).

Despite all these uncertainties in the community, there is always a rainbow waiting. Amidst their darkest lived experiences, there are still best choices to live by, live for and live within in the true colors of a meaningful gift of life. The lived experiences indeed, are the motivating factors proving one's worth and a springboard as well to fight the stigma of the past indiscriminately and to emerge into the society with full respect, dignity and equal protection.

Literature Review

Self-actualization is on top of the hierarchy of needs proposed in the holistic-dynamic theory. It involves the realization of a human's full potential and the achievement of fulfillment. It was discussed in the theory that human beings have varied ways of achieving self-actualization but most of us could disregard our other needs just to reach them. This process of achieving self-actualization is influenced by many things including having peak experiences. Age also affects self-actualization as it could differ depending on where a person is in the stages of development. In connecting the psychosocial stages of development written by Erik Erikson, it is stated that adolescents experience identity versus identity confusion. It is in the ability to establish an identity that one develops the positive value of fidelity (Engler, 2012).

According to Erik Erickson (cited in Feist and Feist, 2008), the adolescent stage is part of human development that comes in between the stages of childhood and adulthood. Adolescents between ages 12 to 20 experience psychosocial crisis of identity versus role confusion. The stage identity versus identity or role confusion is most clearly related to Abraham Maslow's Self-Actualization where adolescents make judgments or decisions about academic, personal/social, and career goals. Adolescents explore the self and try to establish an identity by also setting or choosing certain beliefs, personal values, and goals. Adolescents are becoming more independent about their academics (academic exploration), personal/social (forming of a strong identity and having a sense of direction in life and establishing healthy interpersonal relationships), and career (having plans for the direction of future career). Their self-actualization is then connected to whether they could feel a sense of identity, decide to choose a course related to their identity in college, and make plans for their future based on personal preferences.

In Queer theory, it emphasizes the fluid and humanly performed nature of sexuality – or better, sexualities. It questions socially established norms and dualistic categories with a special focus on challenging sexual (heterosexual/homosexual), gender (male/female), class (rich/poor),

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racial (white/non-white) classifications. It goes beyond these so-called 'binaries' to contest general political (private/public) as well as international binary orders (democratic/ authoritarian). These are viewed as over-generalising theoretical constructs that produce an either/or mode of analysis that hides more than it clarifies and is unable to detect nuanced differences and contradictions (https://www.e-ir.info/2018/01/07/queer-theory-in-international-relations/).

Applying the said theory, the norms of the society as one of the factors for the lived experiences of the LGBTQ++ define their roles including their major contributions despite their diverse characteristics, gender expression and sexual orientation indeed breaking their silence and stand still in the solstice of the limelight.

Methodology

This study was conducted in the City of San Fernando, La Union. Using the key informant interview method (KII), fifteen (15) members of the LGBTQ ++, who belonged to the marginalized group, were purposively chosen as participants. Since, the main objective of this study had something to do with the lived experiences of the participants extracting the factors affecting them, the phenomenological approach as a research design was utilized. Phenomenology is an approach to qualitative research that focuses on the commonality of a lived experience within a particular group. The fundamental goal of the approach is to arrive at a description of the nature of the particular phenomenon (Creswell, 2013).

Initially, a letter of informed consent following the principles of data privacy and confidentiality, was sent to the participants for acceptance and confirmation before the online interview with debriefing of the procedures. In-depth guide questions were provided online. Answers were given via a recorded video until it met their saturation point since the study was conducted during the Enhanced Community Quarantine (ECQ) amidst COVID19 pandemic and following the basic health protocols. In a nutshell, the themes were extracted based from factors affecting their lived experiences. The data gathered were likewise interpreted and analysed. The recruitment criteria were:

The inclusion criteria:
a. The LGBTQ++ are bonafide residents of the City;
b. All are 18 years of age and above; and
c. All are of sound mind and physically capable to answers from 30- 45 minutes.

The exclusion criteria are:
a. Those who were hesitant to recognize themselves as members of the LGBTQ++;
b. Those below 18 years of age; and
c. Those members who are of unsound mind.

Research Objectives

The researcher was guided by the following objectives:
1. To determine the lived experiences of the participants in the vicinity;
2. To identify the factors extracted from their lived experiences; and
3. To describe the coping mechanisms based on their lived experiences.

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Results and Discussion

In this world full of uncertainties, it is really hard especially for the parents to accept fully the gender identity of their children who belong to the LGBTQ++ community as others perceived them differently and stereotyped them with wrong and negative notions discriminately. Amidst all these struggles are the genuine lived experiences with silent battles, closed emphatic feelings of belongingness and of course success stories. Below were the selected lived experiences of the participants showcasing the metamorphic struggles, social turmoil and worth-emulating success stories as factors defining them.

Table 1: The Metamorphic Rainbow: Living the True Colors

Responses	Concepts	Themes
(G5) "When I was young, my grandmother raised me. She really wanted a girl as her granddaughter. So, she clothed me with those lady accessories, put make-up on me, and like. From then on, I was given the freedom to flaunt for who and what I am. I'm out of my comfort zone without any regret and I am happy for being true and now even flying with my true colors".	Freedom Self-Actualization Social Function	Metamorphic Rainbow: Living the True Colors
"(L1) When I was a child, I already felt that I was a lesbian. I did not feel any discrimination from my family members. They were very supportive at all. Never ko ikinahiya na tomboy ako kc eto talaga ako at tanggap ako ng ibang tao.	Self-Acceptance	

The Factor Extracted from their Lived Experiences

In can be reflected that the participants as defined by their lived experiences as members of the LGBTQ++ were both biological and a social function. Apparently, the true definition of love is when the parents and even their relatives embrace the true colors of their gender identity, recognizing their strengths and weaknesses and believing in their potentials as assets in the community. Despite of their desires, they feel comfortable when they see the genuineness of their children although some may perceive them in the negative because of imperfections and most of all with sort discriminations. Garnets and Kimmel (2003) concluded in their study that the location of the house or home of a gay or lesbian adolescent life affects their identity and gender development. In the study of Frisch (2006), gay men report having had less loving and more rejecting fathers, and closer relationships with their mothers, than non-gay men. Some researchers think this may indicate that childhood family experiences are important determinants to homosexuality.

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Table 2: The Comfort Zone

Responses	Concepts	Themes
(G10)"when I was in Grade 1, I had a crush on my seatmate. She's simple, beautiful and intelligent. I was impressed then till I went in Grade 2 when I played during recess time with most of the girls until I already played with them most of the time until I realized already that I became one (a homosexual).	Social Function/ Peer Influence	The Comfort Zone
(B1) "I was confused then because I both love two gender although mahirap kc confusing where to go and how to handle identity crisis until I met a guy of the same feeling. Because of him, I became more liberated and I found the love I'm longing."	True Love	

The Factor Extracted from the Theme

The participants clearly demonstrate how they were influenced by the social milieu through interaction and constant closure with the opposite sex dominated as expected. Playing with them really ignites peer influence but with sense of belongingness, defines sexual identity and even lead to gender role psychosocial development by which as a factor – a social function. Moreover, our society sometimes defines our gender roles because of the norms we lived by and the lifestyle we even accustomed with contributes such factor. Coming out from the comfort zone presupposes freedom: freedom to live, freedom to love and freedom to persevere because of one's value in the society. PsychLogic (2018) defined gender to be the sense and expression of a human being's maleness and femaleness. Different factors could affect gender expression, including culture and varying societal norms.

All adolescents go through the process of getting to know their identity based on the psychosocial stages of development. When they come to the end of this stage, they are expected to have gained a sense of who they are to be able to establish a fruitful and long-lasting adult relationship (Feist and Feist, 2008). According to Bem (1996), on the basis of "exotic becomes erotic" theory (EBE), biological factors, such as prenatal hormones, genes and neuroanatomy, predispose children to behave in ways that do not conform to their sex assigned at birth. Gender nonconforming children will often prefer opposite-sex playmates and activities. These become alienated from their same-sex peer group. As children enter adolescence "the exotic becomes erotic" where dissimilar and unfamiliar same-sex peers produce arousal, and the general arousal become eroticized over time.

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Table 3: The Limelight: Casting the True Colors of the Rainbow

Responses	Concepts	Themes
(G2) "I can confidently say that I am an asset of the society. As a teacher, I mold students. I inspire them to be the best version of themselves. With that I produce competent and value-oriented citizens that could be the catalyst of change in this modern world. Furthermore, I serve as a resource speaker/learning service provider to LGUs and other agencies to augment their needs. I serve as a member of different organizations to alleviate issues and concerns of the community."	Social Asset Flexibility Perseverance	The Limelight: Casting the True Colors of the Rainbow
(G3) "I was bullied at around 8 years old because of my feministic act calling me "bakla" or a "gay". I felt discriminated. My father even told stop from schooling because he felt that being a gay is worthless until I proved my valu e after graduating from college with flying colors and now with stable job. Now, because of my achievements, I can Finally say that being a gay is a blessing And a gift as well.	Self-Worth	

The Factor Extracted from the Theme

It is really hard to prove one's worth especially if you belong to the LGBTQ++ Community but nonetheless, it is worth all-living because of the gift of life and as a social asset. The true color outshines from the moment you go out of the box even if there were social restraints accompanied with sort discrimination. Studying well, finishing a degree course, having a stable job, involvement in social and civic organizations were only some of proven and tested colors that reflect the true worth of the participants notwithstanding their gender identity. Psychalive (2021) defines self-worth as knowing one's value or worth, therefore referring to who a person is rather than what a person does. The participants' self-worth is affected by whether they are contented in life, proud of their personality, and have self-esteem. The participants in the study truly reflected determination and perseverance in proving their self-worth without any fear and hesitation but with fulfilment and self-importance. Everyone's success is a matter of choice and never a matter a chance, the color of choice is the genuine color of tomorrow's success. Casting the rainbow is never unwarranted but a limelight as well.

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Coping Mechanisms

The participants, despite of their lived experiences as members of the LGBTQ++, still proved their self-worth in the community with full-respect, equal treatment and pride. In fact, they strived well in academics with flying colors. Apparently, some already were professionals both in public and private sector. Furthermore, some involved themselves in political, social and civic organizations with advocacies. They viewed themselves with a positive stereotyped social recognition and acceptance indiscriminately. In the long run, laws were even passed protecting their rights in the community in terms of gender equality such as Republic Act No. 11313 or otherwise known as the "Safe Spaces Act"/Bawal Bastos Law".

Conclusion

Despite the sexual orientation and gender identity of the members of the LGBTQ++ in the vicinity, it is of this moment that they embrace their lived experiences and consider their major contributions in the community. From their metamorphic transformation shattered by atrocious experiences and stigmas, still, they broke the silence and casted a shadow of strong empowerment proving their worth and leading the community towards gender equality, free from violence social milieu, friendly relations, full-respect, safe spaces and total social acceptance and recognition. The different factors affecting them indeed, were the true colors in the limelight, flaunting the image of a rainbow solstice full of hopes, dreams and contentment, that in this world, every individual is worth loving for and the glass of silence is worth breaking for.

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TECHNOLOGICAL CAPABILITY ASSESSMENT IN MALAYSIA: MOVING TOWARDS INDUSTRY 4.0

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Abstract: *Industrial revolution will keep on evolving and the manufacturing industries need to keep up their pace to compete and survive with the unforeseen threats by optimizing their technological capabilities. Manufacturing firms are demanded to recognize the state of their technological capability in mapping out their strategy particularly during the fourth industrial revolution (Industry 4.0). Failures to do so will put the future of manufacturing firms at a risky position. However, the crisis of uncertain directions on firms' technological ability can be evades through an effective assessment of technological capability. The assessment work as indicators that measures the extent of firm's ability and, discover their strong and weak technological points thence permit manufacturing firms to develop their technological strength and improve on their technological limitation. As a result, the groundwork of firms' technological capability and its technological development are address efficiently and strategically through the establishment of technological capability assessment model in the manufacturing firms. This paper aims to bring out and discuss about the ground base of technological capability assessment model in Malaysia manufacturing industry. Therefore, related literatures regarding the technological capability assessment in journal articles, online news and books that is related in this study are reviewed.*

Keywords: *Technological Capability, Manufacturing, Assessment Model*

Introduction

Germany introduced Industry 4.0 (IR4.0) in 2011 as its new strategic initiative to create intelligent factories where the production technologies in manufacturing industry are improved and modernized through the cyber-physical systems (CPSs), Internet of Things (IoT) and cloud computing (Zhong, Xu, Klotz, & Newman, 2017). The notion of smart factories are anticipated by the manufacturing industry from all over the world and manufacturing future is expected to be hugely affected by it (Flynn, Dance, & Schaefer, 2017; Ratnasingam, Latib, Yi, Liat, & Khoo, 2019). CPSs introduced the industry with new reality that promote the production process with advanced efficiency and flexibility (Saadi & Razak, 2019). Hence, the relationship that occurred between physical and virtual world in manufacturing systems caused massive transformation that demand the industry to prepare with the new paradigm shift (Flynn et al., 2017; Stancioiu, 2017).

Rapid technological development in manufacturing systems escalates substantial technological challenges and uncertainties for the industry from all over the world (Schumacher, Erol, & Sihn, 2016). The industry is greatly impacted and threatened with the disruptive impact that it

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has on people, process and technology (Stancioiu, 2017). However, amongst these three, technology is known to have the biggest and uncertain impact in manufacturing environment (Stancioiu, 2017). The critical role that technology has demanded the industry to manage their technology from strategic point of view (Mohammadi, Elyasi, & Kiasari, 2017). Apparently, the firms that own technology alone without sufficient capability will unable to undertake the new unprecedented revolution (Saadi & Razak, 2019). Technology is also known as a core function that measure the economic growth and it has captured the attention of many countries in the past couple of years (Majidifar, Zahedi, Jaafari, & Hashemi, 2021). The transformation of new reality in manufacturing industry caught the world in amazement to accommodate the emerging technological revolution (Stancioiu, 2017). However, it is known that many nations are still not genuinely prepared for it (The Economist Intelligence Unit Limited, 2018). They experienced the difficulties in determining the position of their technological capability to improve their state of readiness (Schumacher et al., 2016; Lin & Lai, 2020). Therefore, the issue has become a major threat specifically for Malaysia manufacturing industry that has the potential to produce new technologies independently in Malaysia (Hasan & Ibrahim, 2015). Malaysia manufacturing industry greatest concern is now shifted to the constant development in upgrading the technological capabilities in manufacturing firm (Hasan & Ibrahim, 2015). This is because, the industry is required to arm themselves with the abilities to systematically manage the technology in the entire production process (Schumacher et al., 2016). Industry that capable to handle the technology with superior ability motivate the development of higher level of accuracy, efficiency and flexibility; thus, explain that sufficient capability is essential for one to own (Saadi & Razak, 2019). Malaysia manufacturing industry are urged to be prepared in improving the utilization of new technologies. However, the issue regarding it current state of readiness are still remain in doubt (Hasan & Ibrahim, 2015; Teh & Kee, 2019). As a result, the fierce technological changes and demand required the industry to build a clear direction and approach that lead towards achieving certain standard of ability (Stancioiu, 2017).

Manufacturing industry requires technological capability assessment (TCA) to discover their level of readiness and to help upgrade the domain that need utmost attention (Peters, 2015). The industry must aware and recognize the level of their technological ability and obtain competitive advantage by fully optimizing the technological utilization (Majidifar et al., 2021). Moreover, the degree of readiness in one production line determined the industry result in developing the technology (Seet, Jones, Hordacre, Jones, & Jones, 2018). The industry readiness can be evaluated using the assessment of technological capability. It is a tool that provide an apparent direction in overtaking potential uncertainties faced by the industry (Schumacher et al., 2016). The assessment allows firm to strategically manage their technological planning and develop appropriate ability (Mohammadi et al., 2017). It also enables the industry to recognize the state of readiness in firms present technologies and determine the possibility to move towards new desirable state or vice versa (Peters, 2015; Stein, 2015). The present condition of manufacturing environment, types of abilities required that align with manufacturing goals and the degree of the abilities can be identified through an adequate construction of TCA (Najafi, Masoumzadeh, Alavi, & Nouri, 2019). TCA is not only about identifying and forming the components of technological capability but also paying greater attention towards technology creation and its development process (Najafi et al., 2019). Not only just that, it provides the industries to get hold of their transformation kick-off and initialize the process of technological development (Schumacher et al., 2016). Industries that able to self-assess their current condition, identify the technological strengths and recognize the weaknesses are capable to survive in new technological revolution (Peters, 2015).

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Therefore, it is essential for several countries especially Malaysia to build and structure the TCA that will provide a ground base in identifying and recognizing their state of ability.

Literature Review

Technological capability involves with the ability in managing several components listed as experience, skill, knowledge, resource, expertise, linkage and the organizational structure that is required by the industry in order to encounter with the demand of technological changes (Bell & Pavitt, 1993; Figueiredo, 2007). It is an ability to use the technological knowledge in an effective and efficient way which could strengthen the state of manufacturing competitiveness in the market that can be evaluated through certain approaches, methods, levels, models and frameworks (Kim, 1999; Mohammadi, Elyasi, & Kiasari, 2014; OECD, 1996). Meanwhile, technological capability assessment or technological auditing is recognized as a tool to evaluate the condition of the technology used in manufacturing firm and therefore to analyze the organization's overall position (Mohammadi et al., 2014). It is critical for the manufacturing firm to assess the state of its technology because the production line in manufacturing firms is known to be heavily involved with huge number of technologies and machinery equipment (Porter, 1985). It lets the firm obtain a deeper knowledge towards the ability of firm existing technologies, its current state and allows the firm identify the extent of its capability (Westphal, 1989). The creation of this model is introduced during the third world development to determine the nature of firm's ability in managing the existing technologies, identifying the effectiveness and efficiency of its ability and evaluate the ability to develop technological capability (Westphal, 1989). Although it is vital to perform the assessment for the manufacturing industry to discover its current status and position but unfortunately there is only a few of the theories that encounter with the issue (Lall, 1992; Mohammadi et al., 2014).

The assessment of technological capability can be conducted through several adequate procedures. There are specific assessments about the manufacturing value chain that propose few implications in the organization (Porter, 1985). APCTT (1989) pointed out the technological capability in certain manufacturing firms that could be assessed through four dimensions known as infoware, orgaware, technoware and also humanware with the purpose to evaluate the complexity of manufacturing dimensions and analogize it with the state of art technologies. It is introduced a process approach that divides the technologies own by the firm into two types of categories known as core technologies and support technologies that drive the firm to perform the assessment for its technological performance (Porter, 1985). This approach analyzed the technology from two aspects known as tacit and explicit aspect. Tacit aspect includes the information and complexity in the technological process towards creating the competitive advantage meanwhile explicit aspect focus on the dissemination of the outcome and performance that is easily accessible and transfer (Kabir, 2013). Therefore, it can be seen that the approach used do not prioritize on the end result only but also the complex procedure in obtaining the favorable upshot.

Whereas, there are also few steps that is introduced to let the firm evaluate its capability in the value-added creation and assess the firm technology by using the required significant criteria. Panda and Ramanathan (1996) introduced five procedures to perform the assessment for the organization that aim to boost the firm technological competitiveness. The steps are listed as below:

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1) Identify the value-added phase in the manufacturing chain.
2) Discover the ability required by the firm that can allow the execution of proper value addition.
3) Develop the indicators for the assessment.
4) Identify the status of firm existing capabilities and benchmarking the ability with firm's prior art.
5) Determine the analysis of gap between in the firm technological capability (Panda & Ramanathan, 1996).

Meanwhile, Cetindamar, Phaal and Probert (2009) introduce a model that allow the firm to assess various management levels own by the firm as well as enable the firm to pay its utmost attention towards its primary function. The firm primary function is divided into three categories that are classified as:

1) The strategic overview, defined as the big picture of thorough evaluation that is made on selected areas and the connection between the technology and purpose.
2) The process overview, defined as the comprehensive evaluation for the identification of specific procedures that concentrate on the technology and the components needed for five-process model.
3) The analysis made on the implementation of process overview (Cetindamar, Phaal, & Probert, 2009).

As for the procedures, for the various management levels in firm are illustrated in five steps which are listed as follows: -

1) Identification
2) Election
3) Acquisition
4) Exploitation
5) Protection (Cetindamar et al., 2009).

In addition to that, there is also an assessment of technological capability that is made from the evaluation of only explicit aspect of the technology where the tacit aspect is not applicable (Chiesa, 2001). Chiesa (2001) emphasized that the focus for the assessment is to provide the firm with proper technology selection and development which can set its priorities. The crucial steps in conducting the assessment mentioned are as follows:

1) The identification of existing technologies in every manufacturing sublevels
2) Defined the technologies under the viewpoint of people, processes and requirements for the system
3) Create a ground plan for the technologies based on the qualities of core functions, life cycle and hierarchy
4) Implement the ground plan
5) Evaluate the result obtains by the firm using various analytical techniques (Shamsuddin & Bititci, 2006).

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These steps apply both quantitative approach and qualitative approach to form a broad approach designing an integrated model for technological capability assessment (Shamsuddin & Bititci, 2006). Conclusively, it is known that having an adequate steps and procedures is essential for the manufacturing firm as without them will cause the firm to end up in a wrong stick.

Approaches used for Technological Capability Assessment

There are various approaches and procedures to perform the technological capabilities assessment in manufacturing industry that have been embraced and discussed broadly. The assessment of technological capability can be carried out through several approaches such as framework, model, method, technique as displayed in the Table 1. It explains about the condition of a nation or organization to acknowledge, adapt and utilize their technological capability (Mkalama, Ndemo, & Maalu, 2018). It can be seen that the difference in technological advancement indicates the existence of the variation of technological capabilities and needs among countries and organizations across the globe (Ali, Bashir, & Kiani, 2015). Other methods and approaches that can be used to conduct the technological capability assessment are theory integration approach, direct measures, benchmarking approach, evolutionary approach, proxies measures, model comparison approach and many others. The assessment is to primarily conducted in the national and firm levels due to the limited and insufficient technological resources that it owns (Khamseh, Habibitabar, & Shadkam, 2014).

Table 1: The Assessment of Technological Capability Made on National level

Sources	Approach	Model's name
(Lall, 1992)	Neoclassical approaches & unconventional approaches	National-level technological capability illustrative matrix
(Daniel Archibugi & Coco, 2004)	Authoritative approach	Arco model of assessment
(United Nations Development Programme, 2010)	Technological needs assessment (TNA)	United nation development program (UNDP)
(Khamseh & Mohagheghi, 2013)	Model comparison approach	Technological capability model

Table 1 further displays several assessments that are made on national level together with the approach that is used in developing the model. National level assessment is made from the capacity of thousands firm that gather together in large segregation where the interaction and external factors affect the ability of an individual firm (Lall, 1992). The purpose for the assessment in national level is different from the assessment made for firm level where it is particularly focused to enhance the economy growth and strengthen the industrial structure (Daniel Archibugi & Coco, 2004; Khamseh & Mohagheghi, 2013; Lall, 1992; United Nations Development Programme, 2010). Furthermore, the length of procedures for the assessment made in national level is predominantly evaluated and accumulated from the documented evidence of the nation itself (U.S. Department of Energy, 2015). Lall (1992) pointed out that neoclassical and unconventional approach aims to draw out the results of the nation industrial policy as well as to strengthen certain technological qualities that are realigned with standard set made by the experience developed countries. Meanwhile, Archibugi and Coco (2004) emphasized that an authoritative approach is defined as a balanced approach that focuses on

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the importance of each nation either developed or developing countries that is evaluated adequately under the range of its own acceptable boundaries. This is because, the needs to acknowledge and strengthen the technological capability are known to be varies by each nations and it depends on their technological policies, objectives and plans (Ali et al., 2015). As for the approach used for TNA assessment the approach explains that the evaluation is made from the technological experience in adapting the technology and mitigating the insignificant technology that is owned by the country (United Nations Development Programme, 2010). Meanwhile, the model comparison approach conducted in firm's level explains that it is a method where numbers of related model such as theoretical model and present developed model are studied to compare, measure, and evaluate with one another (Khamseh & Mohagheghi, 2013). Conclusively, it can be seen the existence of extensive literatures that have been conducted on various types of approaches that deemed fit with the corresponding nation.

The assessment in firm-level is usually conducted right after the national-level assessment has been performed since the past 30 years (Figueiredo, 2007). The purpose in performing the assessment is primarily to improve firms competitiveness the market as well as to obtain the competitive advantage (Lall, 1992; Panda & Ramanathan, 1996; Rush et al., 2007).

Table 2: Technological Capability Assessment On Firm's Level

Sources	Approach	Model's name
(Lall, 1992)	Evolutionary approach	Firm-level technological capability illustrative matrix
(Panda & Ramanathan, 1996)	Benchmarking process and direct measure	Model of Panda and Ramanathan
(Rush et al., 2007)	Benchmarking process and direct measures	Technological capability audit model
(Cetindamar et al., 2009)	Theory integration approach and direct measures	Phaal's model
(Khamseh & Mohagheghi, 2013)	Model comparison approach	Technological capability model

Table 2 shows that several models for firm-level assessment together with the types of approach used. Lall (1992) emphasizes that the evolutionary approach where the illustrative matrix is created from the theory that has been integrated. This approach will provide the technological indicator to determine the firm efficiency and effectiveness (Lall, 1992). Meanwhile, the benchmarking approach measures and evaluates the gap of capability that exists in the firm to allow the firm identifies its own strength and weaknesses (Rush et al., 2007) (Panda & Ramanathan, 1996). In addition to that, the direct measures approach is identified to be a time-consuming approach to produce and administer a proper assesment on firm's technological capability (Cetindamar et al., 2009; Panda & Ramanathan, 1996; Rush et al., 2007). These extensive literatures are essentials in understanding the available techniques and approaches to come up with technological capability assessment model.

Technological Capability Assessment Model

Developing countries such as Malaysia should compare the rate of their technological development with the developed countries to experience the technological performance of advance countries (Khayyat & Lee, 2014). Developed countries supposedly own sufficient

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capability in order to deal with the risks of rapid technological revolution while developing countries are known to lack of an effective countermeasure and proned to encounter hence is endangered with huge damages compared than those in advanced countries (Nagano, 2018). Most transformation in competitive countries is identified to be contributed majorly from their technological capability (Shahbaz, Rasi, Ahmad, & Sohu, 2018). Thus, the assessment of technological capability in developing countries is extremely important because it is the most critical element that will spearhead the country to obtain a sustainable competitive advantage (Mohammadi & Kiasari, 2014). The changing demand in technological needs depends on the technological revolution. As such, to remain competitive, the industries in developing countries are required to realign the existing capabilities concurrently with the needs of latest revolution (Yusoff et al., 2011).

Table 3 and Figure 1 depict the number of studies for technological capability that have been carried out mostly in developing countries with less attention to developed countries.

Table 3: Accumulation of Studies for Technological Capability Assessment

Country Group	Countries	Sources	Amount of Studies
Developed	Europe	(Archibugi, Denni, & Filippetti, 2009; Dolinsek, Janes, Cosic, & Ekinovic, 2007)	2
	German	(Gerybadze, 1997; Greitemann, Christ, Matzat, & Reinhart, 2014)	2
	South Korea	(Lee & Lee, 2016; Rush et al., 2007)	2
	Brazil	(Torres & Hasenclever, 2016)	1
	Japan	(Arrison, Bergsten, Graham, & Harris, 1992)	1
	France	(Panda & Ramanathan, 1996)	1
	US	(Schoenecker & Swanson, 2002)	1
	Vietnam	(Son, 2014)	1
	Kenya	(Otiso & Simiyu, 2017)	1
Total			**12**
Developing	Thailand	(N. Gerdsri, Teekasap, & Virasa, 2012; Nathasit Gerdsri & Sangchanchai, 2009; Panda & Ramanathan, 1996a, 1997; Samarnbutr, 2012; L. E. Westphal, 1989)	6
	Iran	(Abbas & Saboktakin, 2011; Doust, Abedi, & Heidarkhanzadehkhameneh, 2018; Khaleghi, 2014; Khamseh et al., 2014; Khamseh & Mohagheghi, 2013; Mirvakili, 2015; Mohammadi et al., 2014; Najafi, Masoumzadeh, Alavi, & Nouri, 2019)	8
	India	(Krasuska et al., 2020; Nagaruju, Raghavendra, Shekar, & Khan, 2019)	2
	Nigeria	(Adepoju, 2019; Dada & Dauda, 2012; Joy & Chukwuneke, 2014; Oluwale, Ilori, & Oyebisi, 2013; Sulaimon, Adebisi, & Odiachi, 2020)	5

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China	(Chen, Meng, & Xu, 2000; Jiang, 2001; Watson, Byrne, Ockwell, & Stua, 2014)	3
Malaysia	(Shamsuddin, Wahab, Abdullah, & Kamaruddin, 2012)	1
Mexico	(Castillon-Barraza, Gonzalez-Angeles, Lara-Chavez, & Mendoza-Munoz, 2018)	1
Russia	(Drozdova & Lyapuntsova, 2015)	1
Indonesia	(Kumar, Kumar, & Persaud, 1999)	2
Sri Lanka	(Assiskumar, 2002)	1
Africa	(Adepoju, 2019; Muyengwa, Dube, Battle, & Mbohwa, 2013; Szogs, 2010)	3
Total		**33**

**Sources for country group: (Kyriakidou, Michalakelis, & Sphicopoulos, 2015)*

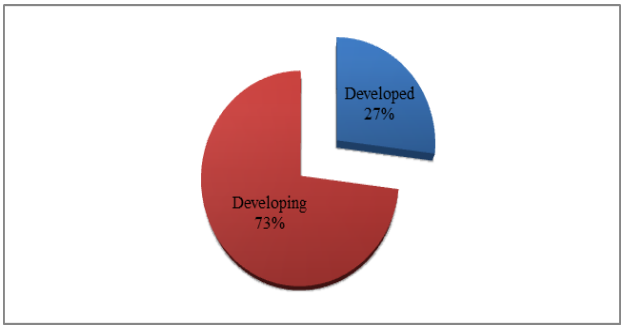

Figure 1: Percentage for Assessment of Technological Capability Studies

Substantially, Malaysia as one of the developing countries is expected to have a promising future. The country has the potential to independently develop the latest technologies and keep up with the rapid technological revolution (Hasan & Ibrahim, 2015). In addition, the technological performance and economic growth in Malaysia is determined by the ability to accumulate and utilize the technological capability. It is a major concern for Malaysia to sufficiently monitor the level and state of present technological capability (Hasan & Ibrahim, 2015).

Technological capability assessment has gained comprehensive acknowledgement and consents from group of scholars and practitioners in all countries (Westphal, 1989). The industrial revolution involves massive utilization of technology to obtain a competitive advantage (Mohammadi & Kiasari, 2014). Technology can be managed efficiently and effectively through the technological capability assessment that focuses on the capabilities as well as to develop the strategy to ride along the growth of the economy (Mohammadi & Kiasari, 2014). Table 4 show that the studies for technological capability assessment were majorly had been conducted in manufacturing sectors as compared to other sectors such as aerospace, healthcare and oil and energy industries.

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Table 4: Accumulation of Technological Capability Based on Sector

Sector	Amount	Sources
Manufacturing industry	23	(Ali, Bashir, & Kiani, 2015; Alizadeh, 2012; Archibugi et al., 2009; Arrison et al., 1992; Dolinsek et al., 2007; N. Gerdsri et al., 2012; Gerybadze, 1997; Greitemann et al., 2014; Jiang, 2001; Khaleghi, 2014; Khamseh & Mohagheghi, 2013; Kumar et al., 1999; Lall, 1992; Mirvakili, 2015; Mohammadi et al., 2014; Oluwale et al., 2013; Panda & Ramanathan, 1996, 1997; Rush et al., 2007; Samarnbutr, 2012; Shamsuddin et al., 2012; Son, 2014; Westphal, 1989)
Aerospace industry	3	(Castillon-Barraza et al., 2018; Doust et al., 2018; Nagaruju et al., 2019)
Oil and energy industry	4	(Adepoju, 2019; Drozdova & Lyapuntsova, 2015; Khamseh et al., 2014; Lee & Lee, 2016)
Healthcare industry	3	(Krasuska et al., 2020; Schoenecker & Swanson, 2002; Torres & Hasenclever, 2016)
Others	15	(Abbas & Saboktakin, 2011; Assiskumar, 2002; Chen et al., 2000; Dada & Dauda, 2012; Gerdsri & Sangchanchai, 2009; Herwiyanti, 2015; Joy & Chukwuneke, 2014; Khayyat & Lee, 2014; Mhatahwa, 2015; Muyengwa et al., 2013; Najafi et al., 2019; Otiso & Simiyu, 2017; Sulaimon et al., 2020; Szogs, 2010; Watson et al., 2014)
Total	**48**	

Manufacturing industry is identified to be one of the most competitive industries that demand the firms to own a realistic understanding of their technological capabilities that synchronously known as a critical factor in determine the outcome of a nation's technological growth (Mohammadi & Kiasari, 2014). The production line in manufacturing industries engages a vast number of plants, machineries and equipments that greatly affected by the new technological revolution (Yusoff et al., 2011).

Technological Capability Assessment in Industry 4.0 Era

Industry 4.0 introduce an intelligent automated factories for the manufacturing industry where the production line, employees, customer and products that are independently connected with one another (Karre, Hammer, Kleindienst, & Ramsauer, 2017). It is a smart factory and is defined as a highly flexible, automated and interconnected manufacturing line that simultaneously can help the firm to produce a large scale of output (Olsson & Yuanjing, 2018). Industrial structures in most nations are known to be dominated by the manufacturing industry (Lin & Lai, 2020). Compared to other sectors, manufacturing industry is known as an industry that will obtain an enormous benefits from the expeditious development and also an industry that will encounter greater risks as well (Stock & Seliger, 2016). Smart manufacturing introduces the organization with the engagement from huge number of technologies. As such, the industry does not need a huge force of human workers to operate on high automated factories but only requires high capability on its technological aspect instead (Olsson & Yuanjing, 2018). The radical changes that are happening in the manufacturing environment have been stirred up due to the fierce transformation of technological revolution (Mulugeta, Muchie, & Kitaw, 2016). It blurs the line between the technology and industry to develop a

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high efficiency rate in the firms and further has become a major concern for the industry to adapt with one (Bakan & Sekkeli, 2017). Therefore, the number of automation that will augment in manufacturing industry in the rise concerns the future feasibility of technological transition (United Nations, 2018).

The industries have high engagement with broad range of machinery equipments and technological application in the manufacturing chain (Bakan & Sekkeli, 2017). Manufacturing industry is demanded to own a sufficient technological capability especially in this smart era of digitalization (Bakan & Sekkeli, 2017). Globally, manufacturing industry is urged to embrace the latest revolution and to survive the intense demand of technological changes (Bakan & Sekkeli, 2017). Thus, in order to compete in the global market, the manufacturing industries in each nation are required to pay its utmost attention on the technological growth, performance enhancement and the industry survival rate (Lin & Lai, 2020). Therefore, the establishment of an assessment to secure sufficient technological ability in manufacturing industry works as an idea for one to transform into becoming one industrialized nation as well as to overcome the issues arised (Lin & Lai, 2020). The assessment tool permit the discovery of technological ability' areas that are effective and the area that required to be upgrade by the firms. It acts as a critical point for the manufacturing industry as it will help the firms to achieve substantial competitive advantage and indirectly enhance firm technological performance (Filho & Moori, 2018). The recent dynamic technological growth indicates the high level of criticalness is to recognize the extent of firms' technological capability however many are still lack of awareness in developing the tools to assess their own development stage (Mulugeta et al., 2016).

The industry faces the greatest threats from the dawn of smart manufacturing (Karre et al., 2017). Therefore, it is critical for the manufacturing firm to adequately manage their technological capability especially in a highly competitive market to allow the firms possess superior technological performance (Lestari & Ardianti, 2019). The technological capability assessment enhanced the adaptation of the technology in the manufacturing firm and concurrently contributes towards the performance enhancement (Al-Mamary, Shamsuddin, & Hamid, 2015). The assessment tool allow the firms to armed themselves with sufficient technological capability thus obtain higher manufacturing performance and higher survival rate meanwhile the firms that are inattentive towards the importance of technological capability assessment are threatened with the risk of having lower capability thus gain lesser performance and lower survival rate in the market (Lestari & Ardianti, 2019). Conclusively, in order for the manufacturing firm to compete with the latest industrial revolution and to survive in intense global competition it is required that the firms to recognize the degree of their ability and acquire adequate technological capability.

Technological Capability Assessment in Malaysia: Towards IR4.0

The new era of technological revolution make it crucial for every nation from all over the world including Malaysia to transform into becoming a nation that is technologically connected and capable to generate, accommodate and fully utilize the global modernization of the technology (Ali et al., 2015). The revolution introduced the newest smart objects, advancement of digitalization systems and integration with IoT in the market (Mirvakili, 2015). Technological advancement is known to be the nature of technology and the current newest revolution caused the transformation of technological nature to be happened (Yusoff et al., 2011). It involves with a high significance of technology that remarkably causes the fierce transformation occurs in

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the manufacturing production line as well (Mirvakili, 2015). It is an unavoidable situation if the organizations want to remain in the competition arena and to advance towards the creation of state-of-the-art technology and the development of technology (Mirvakili, 2015). The small and medium enterprises (SMEs) is identified to have the lesser alternatives to compete with the intense transformation of IR4.0 (Yusoff et al., 2011). SMEs have no other choices than to react and transform towards the radical technological transformation caused by IR4.0. The newest ferocious transformation leaves SMEs from across the globe with no option but to equip and prepare themselves to face IR4.0 head on (Hasan & Ibrahim, 2015). Therefore it is critical for firm to understand the way technology is controlled, the way it was developed and the way technology interrelates with the other manufacturing systems (Mohammadi & Kiasari, 2014). These happened because the changes in technological environment drive the new source of capabilities to arise. The needs for existing capabilities will be toned down as it will become insignificant for sustaining a competitive advantage (Hasan & Ibrahim, 2015). However, manufacturing firms in some countries are not aware towards the existence of IR4.0 in their production system thus neglected the assessment of technological capabilities (Mirvakili, 2015).

Due to this, it is identified that every country is currently in a great demand to build proper technological capability and is urged to keep developing their technological resources because it is known as the pulse for the socio-economic development especially in this modern age (Ali et al., 2015). It is the critical factor that can encourage the nation to obtain a sustainable economic development (Ali et al., 2015). The country that has a higher capability than the others is known to have a better opportunities to compete in the international market and directly own the ability to initiate, accommodate, utilize the global technologies and invent enthusiastically in technology that intentionally drive the nation to be more technology intensive (Ali et al., 2015). The government in each nation is encouraged to allocate substantial share of their budgets to the components that will upgrade the firm technological capability (Khayyat & Lee, 2014). Even so, the manufacturing firms in developing countries are mostly not capable to employ the advanced technology and the reason for the failure is because the firms is lack of knowledge on the state of technological capabilities of their own firm (Mirvakili, 2015). However, the vision and understanding towards the needs of technological capability differs on every countries as it depends on their technological objectives, policies, and plans (Ali et al., 2015).

Malaysia as one of the developing countries considers that technological capability has become a major concern particularly for the manufacturing firm in Malaysia (Hasan & Ibrahim, 2015). The economies of Malaysia are primarily being dominated by a huge proportion of small and medium manufacturing enterprises (SMEs) (Mazlan, Manaf, Ahmad, & Zawawi, 2017). Therefore, Malaysia is much-anticipated with the arrival of IR4.0 that it motivates the nation to pour their efforts in producing great ideas to compete with new technological revolution (Zhong et al., 2017). It aspires to transform the manufacturing sectors to become a technological based sector that could accolade international recognitions by using their firms technological capability (Mazlan et al., 2017). Although the technological development in Malaysia is a little behind than those countries in more advanced economies such as Singapore and Korea but Malaysia's technological performance is somewhat better than the performance of it regional competitors and the nation that shared the same degree of technological development (Hasan & Ibrahim, 2015). The government has also taken several initiatives that allow them to develop and upgrade the technological capabilities so that it can boost the

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industry technological performance thus simultaneously enhance the economic growth (Hasan & Ibrahim, 2015). The existence of IR4.0 in Malaysia is still new in the community and due to its unfamiliarity, it causes the state of SMEs readiness in facing the new era of technological revolution is yet to be understood (Yusoff et al., 2011). SMEs in Malaysia needs to improve the firm technological capabilities so that it can push the nation's economy to the greater degree as well as transform the capability to the higher level of development (Hasan & Ibrahim, 2015). Therefore, manufacturing firms in Malaysia is demanded to recognize the extent of capacity and strengthen the firm technological ability to employ new technologies which indirectly can lead the enhancement on the reliance towards the application of the newest knowledge intensive technologies (Hasan & Ibrahim, 2015). Thus, it is critical for Malaysia to be able to identify whether the industry current condition is in a situation that is fully ready to face with the intense technological revolution or not (Ratnasingam et al., 2019).

Conclusion

Conclusively, it is proven that the manufacturing firms in Malaysia are encouraged to assess the firm technological capability. The assessment of technological capability will be a push start button for manufacturing firms in Malaysia to move towards acquiring sufficient capability and further obtain superior technological performance that will drive towards the enhancement of economic growth. The performance achieved by the firms will be determined by the level of ability that the firms have. It works as core resources to drive the path that will be taken by the firms. Malaysia manufacturing industry needs to explore all avenues provided by the wave of new technological transformation. Therefore, manufacturing firms should make the best out of its resources to obtain a higher possibilities and survival rate in competing with the intense technological advancement (Laugsand, 2017). The numbers of issues that surfaced regarding the assessment of technological capability in global manufacturing industry led this study to review the technological capability assessment. The study in Malaysia manufacturing industry and the existed knowledge gap regarding the technological capability assessment that is found in this conceptual paper uncovers poor data found from the previous researches. Eventually, this paper allows the new exploration and discovery of the broad field of technological capability that impose the needs to be deepen more in future studies.

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STIGMATIZING ATTITUDES TOWARDS PEOPLE WITH MENTAL ILLNESS: CURRENT PUBLIC HEALTH CHALLENGES

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Abstract: *Public health aims to promote healthy lifestyles and the prevalence of mental health issues that affect individuals' psychosocial well-being makes dealing with mental health integral to achieving public health goals. This paper discusses factors influencing attitude towards mental illness individuals at university level and supported by empirically tests the measurement model of attitudes using Structural Equation Modeling (SEM). Other variables involved are knowledge and media. A total of 295 university students in Selangor were involved in this ex post facto study. Cross-validation was done. A well-fitting model was generated with; $\chi^2/df = 1.821$; GFI = .923; CFI = .926; TLI = .915; RMSEA = .029; p = .173. Composite reliability (CR) was .94 and variance extracted (VE) was 69%. Media explains 63% of variance in social attitude. This shows that even though people have knowledge of mental illness, they still have a negative view of people suffering from mental illness and distance themselves from them. Therefore, people suffering from mental illness often face stigmatization and an increase in public awareness and support is highly needed.*

Keywords: *Public Health, Social Sciences, Mental Illness, Attitude, Media*

Introduction

Mental illness refers to the condition of mental state that influences our thinking, behavior and feelings [1]. This study may contribute to a better understanding on mental illness and a guide to a better understanding to public health. Knowledge does not guarantee that society will accept people with mental illness. Knowledge is a fundamental factor to create awareness. Knowledge can be achieved through reading, education, internet and many more. According to [2], young generations have less information about the mental illness and supported by [3].

It is known that although some people receive formal education on mental illness, they still have prejudice towards mental illness individuals. This is the reason why they distance themselves from people with mental illness. Furthermore, some evidence showed that some medical students also have negative attitude and stigmatization towards people with mental illness [4].

[5] stated that attitudes of society towards people with mental illness make them refuse and uncomfortable to visit a psychiatrist when they have emotional problems. Statistics on the risk to commit suicide among adult showing increasing from 7.9% in 2012 to 10% in 2018 in

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Malaysia [6]. Many cases in crime involve the people with mental illness but they avoid from getting treatment because patient of mental illness will get a large social distance from society [7].

The research doing by [8] in public university of Malaysia found that prevalence of depression, anxiety and stress are 37.2%, 63.0% and 27.3% respectively, this is much higher than research doing in private university that prevalence of depression, anxiety and stress are 30.7%, 55.5% and 16.6% respectively [9]. [10] and [11], found that students have lack of knowledge in terms of symptoms of specific psychiatric disorder, treatment and biological causes. Regarding the allocation for mental health by Government of Malaysia, these are the two separate figures we should be taking note of; RM 24 million for the Mental Health Program, Prevention of Physical Abuse and Substance Abuse under the COVID-19 fund and RM 313 million for Psychiatry and Mental Health under the national health budget [12]. Thus, the government has allocated a very big amount for mental health problems. Furthermore, the statistic shows that stigma on mental illness persons is also increasing.

Quantitative research has done by the authors investigating the influence of knowledge and media on the attitudes towards mental illness people among public university students. In this study, measurement of attitude, refers to: 1) Benevolence 2) Stereotyping 3) Restrictiveness. Benevolence refers to the positive attitude toward people that have mental illness like learning about mental disease, help them, do not make joke about mental and respect. Stereotyping refers to your own judgement toward other people that are different from you. Restrictiveness refers to the limit of acceptance toward mental illness individuals.

The main purpose of this study is to develop a model of attitudes towards people with mental illness. Specifically, this study would like to determine whether the instruments are well-fitted model in Malaysian context and addressed the following questions:

1. Does the instruments of attitude, knowledge and media have convergent validity?
2. Does the instruments of attitude, knowledge and media have discriminant validity?
3. Will the combination of attitude, knowledge and media be a well-fitted model in Malaysian context?

Materials and Methods

Sample

The total participants in this study were 295 representing 45% male and 55% female participants. All of them were 20 to 25 years old and randomly selected from public university around Klang Valley, Malaysia. The questionnaire was group administered to the students with permission from the universities. The participants were given brief description of the research project and the process of informed consent was done.

Instrument

Three instruments involved to answer the objectives. To measure the attitudes of students, researchers adopted instrument of Attitude towards Mental Illness (AMI) scale that has been designed by [10] with 17-item. Alpha coefficient for this instrument was 0.84 and the value of convergent validity was a=0.83. The instrument involved three focus areas that were (1) benevolence, (2) stereotyping and (3) restrictiveness. Second instrument to measure the

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influence of media was adapted from [13]. Subconstructs were: (1) Stigma section and (2) discrimination. The alpha coefficient was 0.78 and the value of convergent validity was 0.83. The third instrument to measure knowledge of mental illness was adapted from Knowledge and Attitude about Mental Illness (KAMI) by [10]. The subconstructs are 1) Factual knowledge 2) Illness Identification; with the value of alpha was 0.83 and convergent validity of 0.63. Back-to-back translation was done for the three instruments and was referred to two experts in English and Malay languages. The students were required to indicate their beliefs and conceptions of the attitude towards people with mental illness by 5-point Likert scales. Each statement was worded in a manner to capture the meaning attached to one of the dimensions.
To assess the reliability of the instrument in this study, the researcher made use of estimate of composite reliability and average variance extracted, which are commonly used measure to test the extent to which multiple indicators for a latent variable belong together. Further confirmation of the overall fit of the measurement model using Confirmatory Factor Analysis (CFA) was obtained from the Maximum Likelihood estimation, Chi-Square (χ^2) statistics produced by AMOS (Analysis of Moment Structures) and various other goodness-of-fit criteria.

Results

There was an acceptable level of model fit for the measurement model as suggested by [14; 15]. Further confirmation of the overall fit of the measurement model using CFA was obtained from the Maximum Likelihood estimation Chi-Square (x^2) statistics produced by AMOS and various other goodness-of-fit criteria. The ratio of χ^2 to degrees-of freedom (df), should not exceed 3, adjusted goodness of fit index (AGFI) should exceed 0.8, non-normed fit index (NNFI) and comparative fit index (CFI) should exceed 0.9, and root mean square error of approximation (RMSEA) should not exceed 0.08. The x^2 test of absolute model fit is sensitive to sample size and non-normality [16].

A better measure of fit is chi-square over degrees of freedom (x^2/ df). This ratio for the proposed model in this study was 1.821, which is within the suggested value while Goodness of Fit Index (GFI) was 0.923, CFI was 0.926 and Root Mean Square Error of Approximation (RMSEA) was 0.029; Composite reliability (CR) was .94 and variance extracted (VE) was 69%. All the model-fit indices exceeded their respective common acceptable levels suggested by previous research, thus demonstrating that the measurement model exhibited a fairly good fit with the data collected. This shows that a well-fitting model was generated.

The reliability of the survey instrument was established by calculating Cronbach's alpha for the purpose of measuring internal consistency. Most of the score was above the acceptable level, that is, above 0.70 as suggested by [17] while the convergent validity of the factors was estimated using composite reliability and average variance extracted. Convergent validity refers to the consistency that multiple items exhibit in measuring the same construct.

Average variance extracted (AVE) and composite reliability (CR) are adequate indicators of the convergent validity of measurements [14]. Thus, they were included in the study. Composite reliability in the measurement model was above 0.7 as suggested by [18]. The average extracted variance was above the recommended 0.50 levels [19]. Convergent validity can also be evaluated by examining the factor loadings from the confirmatory factor analysis.

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Table 1. Assessment of Discriminant Validity

	Attitude	Knowledge	Media
Attitude	**0.94**		
Knowledge	0.87	**0.89**	
Media	0.72	0.66	**0.87**

Diagonal elements represent the square root of the average variance extracted (AVE).

Discriminant validity is the degree to which items differentiate between constructs or measure different constructs [20]. Researchers used the criterion established by [16] to assess the discriminant validity. According to the criteria, for each construct to possess sufficient discriminant validity, the square root of AVE for every individual construct should be greater than construct's correlations with the other factors. Table 1 presents the result of the discriminant validity of the measured scales. AVE values are greater in all cases when compared with off diagonal elements in their corresponding rows and columns. This provides sufficient evidence for the discriminant validity of the scales used [16].

Table 2: Goodness of Fit

Latent Variables (cross validation)	χ^2/df	GFI	CFI	RMSEA
Knowledge	2.41	.913	.914	0.04
Media	2.35	.918	.926	0.05
Attitude	1.26	.921	.938	0.03
N=295	1.821	.923	.926	0.03

All the items loaded significantly to the three factors. The direction and magnitude of the factor loadings were substantial and statistically significant. The model is free from offending estimates and the internal consistency estimates satisfied the standard deemed necessary in scale construction.

The goodness-of-fit results indicate the hypothesized model is consistent with the data (Table 2). RMSEA has been recognized as one of the most informative criteria in covariance structure modeling. The RMSEA takes into account the error of approximation in the population [21]. To further validate the likelihood of the hypothesized model, cross validation was applied on the data collected from 130 and 148 students. The results of this analysis are presented in Table 2 in cross validation model shows the well-fitting model.

Values less than .05 indicate good fit and values as high as .08 represent reasonable errors of approximation in the population. For CFI (Comparative Fit Index) and GFI (Goodness of Fit Index), values close to 1.00 being indicative of good fit. Although a value of >.90 was originally considered representative of a well-fitting model, a revised cutoff value close to .95 has recently been accepted [21]. Because the CFA model focuses on the link between factors and their measured variables, within the framework of Structural Equation Modeling (SEM), it represents what has been termed a measurement model.

All items have non-zero loadings to the three factors. This means, all the items loaded significantly to the three factors. The direction and magnitude of the factor loadings were

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substantial and statistically significant. Analysis of the items resulted in a well-fitting model; n = 295 (χ^2/df = 1.821; GFI = .923; CFI = .926; TLI = .915; RMSEA = .029; p = .173.). Results showed that both knowledge and media influence the attitudes toward mental illness people. The goodness-of-fit results indicate the hypothesized model is consistent with the data and media contributes strongly to attitude in this model (R^2 = .63).

The model is free from offending estimates and the internal consistency estimates satisfied the standard deemed necessary in scale construction. Both the fit indicators, the GFI and CFI exceeded the threshold of .90, the standard deemed important for model fit [11]. Furthermore, the root means square error of approximation (RMSEA=.029) indicated a well fitted hypothesized model. Therefore, the above results show that:

i. All the three instruments have convergent validity.
ii. All the three instruments have discriminant validity.
iii. The model of attitude with knowledge and media as the contributing variables is a well-fitted model of university students in Malaysian context.

Discussion

Media explains 63% of variance in attitude. In other words, the variation of 63% shows that media strongly contributes to attitude towards people with mental health in this age span. This study set out with the aim of assessing the importance of media and knowledge about mental health among university students. Results also showed that both knowledge and media influence the attitudes toward mental illness people. This shows that even though people have knowledge of mental illness, they still have a negative view of people suffering from mental illness and distance themselves from them.

Attitude can change by experience with mental illness people. [23] stated that, nurse or anyone that have experience in average time 4 week with the mental illness person will have more positive attitude toward the patient that have mental disease. This finding is also supported by [24] and [25] where they found that people who have experience with mental illness patients shows positive attitude towards them.

According to [26] knowledge can reduce stigma on mental illness. It helps to delete the negative perceptions and stereotypes towards mental illness disease. Furthermore, [27] stated that media is one of the most significant influences in developing societies because it shapes our ideas and ways in which we understand those around us. This situation happens because society gets a lot of information regarding health through media [28]. Negative views on media regarding mental illness person give impact in overall process of recovering.

[29] stated that media could be classified into seven types: books, newspapers, magazines, radio, movies, television and the internet. This showed that young generations have various ways to get information about mental illness but if these mediums only expose about the negative side of mental illness, it will increase the stigma and myths on mental illness. The media is also a powerful channel because people tend to trust messages delivered by the media and most people are unable to critically evaluate the information [30].

According to [31], media can play important role in reducing stigma on mental illness with condition that media do collaborate with mental health professionals to make sure the

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information given is accurate and the right information is delivered about the illness. Furthermore, media should be the platform to spread mental health awareness around the world.

The results of the present study forward evidence for construct validity for knowledge, media and attitude. Furthermore, all instruments demonstrated evidence of internal consistency reliability, reliable and valid measures to be employed in assessing attitude, knowledge and media. Evidently, the current study which made use of the instruments in Malay version yields consistent findings with previous studies which used the English version of the measures.

Conclusion

Campaigns on mental health issues should focus more on changing students' attitudes toward people suffering from mental illness. Media and knowledge of mental illness play a key role to deliver the accurate information about mental illness. Future research should examine social distance of people with mental illness, beside the attitudes, so that the findings will be more comprehensive.

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HOW TIKTOK IS AFFECTING YOUTH: POSITIVE AND NEGATIVE EFFECT ON BEHAVIOUR

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Abstract: *Short video industry has been on the fire after the invention of an application of social software called 'TikTok'. This application went viral starting from September 2016. TikTok was widely used by multi-level of ages and background. For some, users used TikTok for entertainment, business purpose and marketing promotion strategy. Instead, out of positive function and affect, there must be the vice versa about TikTok. This study is about to highlight the effect of TikTok on youth in the positive and negative sides. This research method carried by having an investigation and reading on previous study to collect the specific data and to make a conclusion about the topic of study. In conclusion, TikTok application indeed giving positive and negative impact on youth depends on their aim for using TikTok.*

Keywords: *TikTok Application, Short Video, Social Software, Impact, Youth.*

Introduction

In the era of mobile internet, it can be seen that there are no exceptional for everyone to not have at least a gadget in their daily life management, and it is including teenagers and students. It was a trend today for everyone to demand a smartphone to sustain their lifestyle on the purposes of information sharing, daily activities, business activities, educations, entertainments, and social network. In addition, most of industries are now demands an online system (Xiaohui Yan and Zhengwu Zhang, 2019). The "Tik Tok" App explosions in 2017 shows that short videos trend are giving a great significance to the theoretical research of the media academic community. TikTok that numerously knows as short video software offers field to study short video to short video industry.

The mobile video technology and sharing application has conquered the sight of youth audience around the world. The result shows that TikTok has become the most downloaded Apple iOS video app among youth ages between 13 to 18 years old. This data break the half of the 500 million users across the countries and regions (Chen, 2018). According to market analysis by Sensor Tower, the TikTok app is the most downloaded compared to Facebook, Instagram and

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Snapchat. Therefore, it can be concluded that TikTok has win consumers heart and more popular among the other social media applications.

Social media applications that promise this versatility is inevitably have a variety of positive and negative effects of their own. These effects need to be identified as the use of the TikTok app is widespread without any control and strict review of shared content (Bahiyah and Wang, 2020). In addition, the developer of the TikTok application stated that this application is suitable for users as young as 12 years old. Therefore, this study will examine the positive and negative effects of the TikTok application among youth (Chen, 2018).

TikTok Usage among Youth

According to research done by Christian, Haibo and Jon (2021), TikTok was developed in China and became their most successful social media application in the globe. Since it was founded in September 2016, TikTok was rapidly increased in number of users. TikTok's are complete with interesting features that attracted most of youth in viewing, creating and commenting on shared videos from the app page. Until November 2019, TikTok application recorded 800 million monthly users and approximately 738 million for first time installs. This application gained more user attention is because TikTok can be used by those 13 years old or older, but the direct messaging was strictly allowed between people ages 16 years old or older to prevent young user from misuse the application. Besides that, research stated that most of the TikTok users are below 35 years old which this group represent majorities of youth. Meanwhile, in order to make TikTok safe for young user from negative content and inappropriate behaviour such as smoking, drinking and rude language, the TikTok engineers has developed a version of the app which functioning in filtering the contents for young users. But, how far this system helps to protect them from the vulnerable and negative contents?

TikTok can be installed by any users as long as they owned a smartphone, and the application can be downloaded from Android Play Store or Apple iOS App Store. How's TikTok work? TikTok is the innovation from video maker application which able to create short video and users may perform playback-videos to add on sound or music. Besides, TikTok is complete with stickers, graphic effect, filters, texts, and voice-over function. In addition, some of the most 'viral' features on TikTok is 'lipsync-videos' and 'challenges. The variety of TikTok trends such as dancing, singing, cooking, exercising and tips sharing will encourage the other users to work on their own video content to catch viewer sight (Christian et al, 2021).

People tend to use TikTok for their personal purposes such as entertainments, relaxation, tips, ideas, lifestyle, fashions and news. There are similarities with TikTok and Instagram which both medium allows access to short videos, provide comments, and heart for users to interact with the contents and the users itself. Besides, users could communicate with their network by sending them messages easily because every social media app designed with mobile-friendly interface. Other than that, TikTok is very friendly to promote business, products, and marketing strategies. Moreover, compared to other social media, videos content in TikTok catch viewer attentions in a blink of eyes whenever their videos cross over people's page. According to Correa, Hinsley, and de Zuniga (2010), there are some reason why the numbers of TikTok users are increase. There are some of the reasons why people spend so much time scrolling on TikTok pages:

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i. Social media fulfil the needs for communicate and interactions with others
Using TikTok and the other social media that have similar features, people able to send instant messages, comments, and response to their content by just clicking the 'like' or 'favourite' button on the video they watched, all of which facilitate social interactions.

ii. Social media as life content gallery
People on social media will take photo and video on their activities, special events or occasion in their lifetimes and posted them on social media to remember. This is why social media can be call as their album or gallery as it is about the need to, they can recall back the memories in their personal space. Same goes to TikTok which the entire event were summarized into video.

iii. Draw people attention and showing off talents
Content creators that have different talents and techniques in making posting will get the highlights from the audiences. Through this platform, they are able to show their capabilities and specials and cultivate supportive connections. In TikTok context, self-expression involves using videos to express about them or impress the audience with his/her talents.

iv. Entertainment and relaxation medium
Whiting and Wiliams (2013) found that people are encouraged to escape themselves of the day to day pressures using social media. They found that social media are the fun and joyful platform to watch activities like music, comedies, and meme's. The social media gave them a pleasurable fun and joy. The need for escapism is expected to be associated with TikTok which offer so much videos, challenges, and lips-sync.

v. Peeking on people's live
This factors motivate people to use social media as their own benefits to find as much as information about someone. Voyeurism or peeking on people live was the most common reason for using social media. In the context of TikTok, people will publish their daily activities and talents to others to reach more views, likes, and shares.

All of these factors of using TikTok will sometimes lead to dangerous effect on users or creators especially among youth where they are access to TikTok freely without parenting control or filters on the contents. In conjunction with the increasing on the TikTok users, social media are always facing a scenario in giving effect to people through positive and negative ways. This research focused on the effect of TikTok on youth behaviour.

In the early-to-mid 2000's, social media has expands among society and become an important development aspect for youth (Subrahmanyam, Smahel, & Greenfield, 2006). These online and offline contexts among youth are strongly connected to make sure their daily routine is complete. Hence, this social media fever has brought up hypothesis that social media context their offline developmental issues related to youth identity, autonomy, peer relationship, sexuality and risk taking and sensation seeking. This paper will sum up the positive and negative impact brought by TikTok app on youth development especially, the effect on youth behaviours. According to Barry, Sidoti, Briggs, Reiter and Lindsey (2017), indeed that social media is mostly everywhere around youth generation. 93 – 97% of 13 – 17 years were signed up to as less as one social media platform. As youth are the most generation whom occupied

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to social media application, they spent so much of their free time wandering on the pages. Report stated that, the average period over day spent nearly 3 hours (Barry et al., 2017). There is an expansive literature related to social media that giving a scenario to psychosocial development on youth including self-esteem, social relationship, peer victimization, internalizing problems, delinquent behaviours and sexual self-exploration (Seabrook, Kern, & Rickard, 2016).

Theory of Uses and Gratifications

Many people have used UNG Theory to study why people use social media. But there are fewer that define "use" in terms of the three main ways people use social media which is to consume content, to participate or engage, and to create user-generated content. Users of TikTok are driven to consume by the desire to escape reality, pass the time, and experience amusement. TikTok users are motivated to participate on the platform by the opportunities it provides for archiving, social interaction, and the development of a community. Self-expression, creativity, and the fact that TikTok is simple to use are three of the key draws that encourage users to upload material to the platform. In conclusion, users of TikTok are driven to consume, engage in, and produce content on the platform by a wide range of motivating factors. TikTok has a large user base, and many of those users have admitted that they produce content with the app in addition to using it to consume other people's creations.

According to Athwal et al. (2018), Tiktok user predominantly seek emotive and cognition-based gratifications, but they also seek escapist and time-passing gratifications. These findings are consistent with those of Whiting and Williams (2013), who found that users use social media to kill time. According to Vela (2020), the average user spends about an hour per day on TikTok, and 63% of users recently liked a video that someone else had shared (Marketing Hub, 2020). It is clear that people are engaged across various social media sites, not only TikTok.

Using the Uses and Gratifications (U&G) framework, we can see how people use TikTok in terms of consuming, participating, and generating behaviours, as well as the impact of personality factors and user motivation in predicting this integrated usage behaviour. Reviewing UGT studies on user motivations to be active users is crucial, for these reasons. The UGT approach has been applied to social media through the implementation of studies that are considered to be important and which list a number of the motives that users rely on inside a variety of scenarios. Several research, such as Flecha-Ortiz et al. (2019), Choi and Sung (2018), and Athwal et al., provide a higher depth of understanding by listing motives that are special to industry or platform. For example, Flecha-Ortiz et al. (2019) lists the motivations that are unique to distinct platforms (2018).

Problem Statement

Social media abuse is a source of moral decay among students today. Among the main effects is that students easily follow things that are neglected as well as follow western culture for sheer pleasure. Furthermore, with the diversity of electronic social media such as hardware (gadgets) supplied with unlimited internet facilities, it indirectly has a huge impact on student morale. As a result, there is a change of foreign culture through various Jewish schemes that seek to corrupt the morals and lifestyles of today's young generation, in order to live in a culture of Hinduism and humanism in order to fulfil aimless pleasures in the future. This Hindu culture causes students to waste a lot of time with online games such as PUBG, Dota and so on. Even

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students can easily follow western cultural trends such as the culture brought in the film and music industry, where elements of humanism are highlighted like films adapted from comics that show human greatness beyond the power of God. In addition, today's students are affected by the era of globalization in the development of telecommunications technology and social media that provide coverage in every corner of the world without borders and no proper monitoring from responsible parties; this makes students vulnerable to negative influences. Reality television contains many elements imitated from foreign cultures, programs and dramas featuring free association, violent stories in the form of violence and programs that are purely entertainment. The effect has a lot of influence on students on the appearance of morals that are contrary to Islamic law. Thus, polemics about social issues among students are actually the result of the influence of the social media industry. The development of the media industry in Malaysia must be given monitoring in the use of media to avoid the elements that contribute to the collapse of student morale. This problematic situation prompted researchers to make a study related to the impact of social media on moral decay among students. This is because students are an asset to the social, cultural, political, sports and economic development of the country the future and the next generation to today's leadership that will lead the nation towards a developed nation. Therefore, the problems that arise among them need to be given due attention to provide preparation towards the excellence of knowledge, morals and various knowledge needs to be done from now on. By having this issue in research, an early step can be taken to prevent the misuse of social media among students. Besides, each level of related management such as parents and school are aware about the positive and negative impact by letting their children access to media social. Nowadays, social media are widely use in education, business, or any related business to have people to catch up with one and another. But, guidelines or rules for the use of social media need to be established to ensure its use in a positive way.

Research Objective

This study was conducted to determine the impact of social media especially TikTok on behaviours among youth.

Research Significant

The significance of the study conducted is:

a) To enable the authorities such as the Ministry of Education, Ministry of Information, Ministry of Arts and Culture and the Ministry of Youth and Sports to set the specifications of the programs that are shown and monitoring is done to be suitable for all levels of society.

b) This study allows educators to instil the idea of positive behaviour in their teaching and learning process.

c) This study allows parents to monitor their children in the use of 'gadgets' to benefit them.

d) This study is also expected to make the community aware about the change in behaviour among youth within their eyesight and help to execute any physical abuse that can be seen around.

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Methodology

The quantitative research approach was used in the formulation of the research plan for this study. In order to collect data from the respondents, a survey was designed. The method of purposive sampling was used to obtain the data for this study's 400 questionnaires. On the basis of earlier research, the research team needed around three months to construct the instrument that would be used in this investigation. The perceived usefulness and the perceived ease of use shall serve as the domains for the purpose of this essay. The instrument was put through a pilot test with twenty participants, and all 10 domains had a Cronbach alpha value that was more than 0.7. This indicates both the instrument's validity and its reliability. In order to collect data during this epidemic, an online poll served as the primary method of information gathering. Both SPSS and SMARTPLS were used in order to do the analysis on the data.

How TikTok's Effect Youth Behaviour?

Positive Effects

During the Covid-19 pandemic, social media platforms integrated with short videos have been playing an important role, when the education system switches into online courses. The usual physical teaching and learning shifted to virtual classes. This mode of education requiring internet and social media application much more like a middle person to gather teachers and students situation. Previously, the most frequently used social media platforms are Facebook, Instagram as well as WeChat and WhatsApp by English language educators, English language teachers as well as college students and college staffs. However, starting from the year 2019 especially after the outbreak of Covid-19 pandemic, there is a newly emerging popular social-media among youngsters, which is TikTok (Xiuwen and Razali, 2021). Escamilla, Alguacil & Lopez-Carrill (2021) indicate that a unique feature of TikTok in making short videos easily and it's increasing popularity among Generation Z. As the Covid-19 struck the world, so many sectors that shut down now slowly adapted to virtual and online working systems. Education sector are not exceptional, with the classic teaching and learning process has stopped, the students has a lot of time spent on their gadgets. Foresee this issue; our Ministry of Education had developed new teaching and learning process through online classes. By having so many features on developed social media, TikTok's is one of the chosen medium to create a creative educational and lesson short video.

Social media have transformed the culture of human's communication and socialism. Education environment is one of the fields that involve in the transformation which online learning method are increasingly in used. After the COVID-19 outbreak, the uses of online courses were accelerated and TikTok's application is used as a pedagogical tool. Escamilla et al., (2021) recommended TikTok's to be a teaching and learning tool because this application suited the expressive and creative content. The feature from TikTok's that having text, movements, musics and pictures encourages the development of skills such as creativity and curiosity. Here, students will show their capability in developing the learning content in a simplest way. In TikTok's community, the content creator will give tips and teaching everything based on their background knowledge such as doctors, chefs, entrepreneurs, businessmen, educators, and fitness couches (Risma, 2020).

Besides the positive impact in education field, In December 2019, a new severe respiratory coronavirus infection (COVID-19) was detected and has since spread over the globe to be ultimately declared a pandemic by the World Health Organization on March 11, 2020. For physicians and allied medical professionals, this moment has been marked by an increased and

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rapidly changing flow of information from multiple regional, national and international health authorities, regulating bodies and professional associations (Eghtesadi and Florea, 2020). Despite the social media platforms have an active presence in spreading information and medical professionals display active participation in them, traditional channels such as email are still being consumed as a means of communication. Social media platforms such as Facebook, Reddit and TikTok disseminate medical information both for the use of physicians and as a means to communicate essential information to the public at large. This positive use of TikTok will deliver awareness to all users especially youth generation who spent a lot of time on social media. Automatically, we will restore the knowledge about health and any information that encourage them to help others.

Palupi, Meifilina, and Harumike (2020) carried a research on how TikTok application influencing self-confidence level in regular students. Many of youth use internet to showing off and seeking for popularity and public attention. Social media giving a place to all users to easily share post and create content. Through TikTok, as a video-visual social media application, users can share creative ideas to get their viewers and likers. TikTok is commonly used by students as a place to express them for being unique, attractive, highly intelligent individual and having more potential than others, in fact, they try harder to be outstanding and extraordinary to be a 'TikTok Famous'. Through this way, they may build seld-confidence to impress the viewers and try something new.

Negative Effects

In this recent year, TikTok have been widely used especially among teenagers. Understanding the relationship between social media use and risky behaviours among adolescence is crucial given that changes to brain structure and internet function with an amplified sensitivity to uncontrollable peers influences to confer an increased propensity risk taking that is unique to this developmental period (Casey, 2015). Indeed, engagement in risky behaviour most often begins during adolescence including those behaviour that expose youth to harm or significant risk of physical injury or death such as substance use, unsafe sexual acts, and violence related behaviour (Steinberg,2010).

Moreover, most of the proportions of adolescents engage in risky behaviors. In the U.S., in respect to use in the past 30 days, 20–30% report having consumed alcohol, 13–15% binge drinking, 5–14% using cigarettes or smokeless tobacco, 12–13% vaping, 14–20% using marijuana, and ~16% carrying a weapon (Johnston et al., 2018; Kann et al., 2018). Physical violence also is a thypical issue, as one out of four adolescents report getting into at least one physical fight with peers within the past year (Kann et al., 2018). Adolescents who are sexually active often engage in unsafe sexual acts, with 34–46% unprotected sex and not using condom and 5–14% not using any pregnancy prevention method (Abma & Martinez, 2017; Kann et al., 2018).

Despite the high prevalence of risky behaviors, overall trends suggest that several major risky behaviors have declined within the past 10–15 years among adolescents, including cigarette smoking, binge drinking, marijuana use, violence perpetration, and teen pregnancy (Johnston et al., 2018; Lewycka et al., 2018; Sedgh, Finer, Bankole, Eilers, & Singh, 2015). However, the prevalence of other forms of risky behaviors, including vaping and sexting, have increased markedly within this time frame, and engagement in unsafe sexual acts, such as a lack unprotected sex without condom use, has remained stable and pose threats to the health and

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wellbeing of adolescents (Madigan, Ly, Rash, van Outsel, & Temple, 2018). These risky behaviors are connected to numerous adverse health outcomes, legal consequences, and premature mortality (Kann et al., 2018), highlighting the need to understand their relationship to adolescents' social media use.

Refer ro Abdul Jaffar, Riaz, and Mushtaq (2019), study shows that such image focused apps lead to several mental health issues like body dissatisfaction, eating disorders, narcissistic personalities and anxieties. Study indicates that the usage of TikTok application lead to child pornography, cyber bullying and parental disengagement. In the other hand, it is very important to know how TikTok has been playing a crucial role in youth lifes. The closer person to get the youth under patrol is parent. Parents have to be aware of what their children access in this app. Besides, parent should pay more attention in their children changing behaviors. This is because, study proves that TikTok has brought more negative impact to youth generation comparing to positive impact (Abdul Jaffar et al., 2019). As it is being discussed, study carried by Abdul Jaffar et al., (2019) parents' feedback on TikTok Apps-store has been summarized into the Table 1.0 below:

Table 1.0: Parents Feedback on TikTok Apps-Store

Inappropriate Content	Privacy and safety	Mental Health
Inappropriate songs and lyrics	Poor privacy precautions	Depressing
Promoting nudity	Sexual predators	Cyber-bullying
Adult language	Privacy setting not working	
Mature content	Paedophiles	
Pornography	Private accounts do not help	
X-rated contents	Not for kids under age 16	
More of inappropriate content		
Graphic violence		
Toxic and offensive app		
Mature eyes only		
Nasty app for kids		
Disturbing and addicting		

Youngsters who were addicted to TikTok or any other similar social media apps, they will having a future endanger, which their mindset of the young children are ruined by so much inappropriate contents that did not suitable for their ages. Besides, the situation create by social media also exposing young children to be cyber stalking, online predators and being a victim of criminal offense.

Furthermore, the use of TikTok Apps brought users to the addictions that will affect us in a various way.

Irfan, Irum, Muhammad Bilal, Mohad Sadad and Naila (2020) have adapted a survey beneficial to empower the awareness among people that addicted to something un-useful to their family. This research taking a serious mark to cut out TikTok user to have some guide to not to over addicted in creating contents and influence by uncertified contents out there. The main reason being, children that followed this viral app are vulnerable to pornography. In addition, for the recent past, there have been many cases where people have hurt themselves very seriously while making videos for TikTok. Some of these serious injuries even resulted in deaths. For

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examples, in February 2019, a college student from Tamil Nadu died as his scooter rammed into a bus. Three students, Surya, Reagan, and Vignesh were having a joyride on a scooter while one of the pavilion riders was making a TikTok video. It is evident in the video that the bike lost balance and smashed into a bus resulting in the death of one of the three (Irfan et al., 2020).

Other than addicted on TikTok will lead to low grades and CGPA in student's education performance, this app is also allowing to psychological disorder. There is positive significant result in relationship between social media and psychological disorder resulted in study carried by Bargh and McKenna (2003). Their research claims that students will spend most of their quality time on social media without having worries about their studies. As they surf more on social media, they are expose to other people personal life that not even true in the picture. These fake lifestyles will develop students' insecurities that lead them to psychological disorder. In contra to someone who is having a very high level of self-esteem, they will categories as narcissism. This situation exists whenever a person got so much compliments and having a group of supporters rooting for his/her activities on social media that lead to egoism. These adolescents are in their developing phases from babyhood to maturity ages. Excessive social media sustains health problems such as anxiety, depression, frustration, lonely and sadness. At last, social media will destroy their life by mental harassment, cyber intimidation, infringement and having a tendency to decrease the social community participation (Bala, 2022).

Conclusions and Outlook

Although user numbers are high and TikTok represents a highly successful social media platform around the globe, we know surprisingly less about psychological mechanisms related to TikTok use. In particular, when studying a platform such as TikTok receiving attention at the moment from a lot of young users more specific needs or facets of the broad dimensions of uses and gratification theory such as social usage being more strongly related to the needs of adolescents might need more focus. One such focus could be a stronger emphasis on the study of self-esteem in the context of TikTok use. Work beyond this area, for example investigating potential detrimental aspects, are scarce, but will be important. In particular, we deem this to be true, as TikTok attracts very young users, being more vulnerable to detrimental aspects of social media use. We believe that it is also high time for researchers to put research energy in the study of TikTok and to do so in a comprehensive manner. Among others, it needs also to be studied how active and passive use impact on the well-being of the users. This means that the here-discussed how, why, and who questions need to be studied together in one framework, and this needs to be done against the data business model and its immersive platform design. So much research need to done to understand TikTok use and related aspects that need to be control to secure our youth generations.

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DISPERSION OF SOLUTE IN CASSON FLUID THROUGH A STENOSED ARTERY WITH THE EFFECT OF BODY ACCELERATION

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Abstract: *Body acceleration and slip velocity effects towards the dispersion of solute in Casson blood flow through a stenosed artery is investigated mathematically. Momentum and constitutive equations are solved analytically to obtain the blood velocity. Convective-diffusion equation is solved using Generalized Dispersion Model to obtain dispersion function and mean concentration of solute. A study has been conducted on how body acceleration and slip velocity disturb the dispersion of a solute in blood flow. With the increase of slip velocity and body acceleration, blood velocity increases. The impact of body acceleration on blood flow is to increase flow rate while lowering resistance to flow. Casson fluid is a suitable fluid model to examine the blood velocity and drug transport to the targeted problematic region through a narrow artery for the treatment of arterial diseases. The findings of the present study can be beneficial for pharmaceutical research to design better drug by referring mathematical analysis data that produced in this study.*

Keywords: *Body acceleration; Slip velocity; Casson fluid; Dispersion of solute; Generalized Dispersion Model*

Introduction

Stenosis of an artery is the narrowing of the area of blood supply in the artery by forming arteriosclerosis plaques due to fat deposits, cholesterol, and so on the inner wall of the artery. Healthy eating, exercise, cigarette smoke reduction, and alcohol intake management may all help to prevent CAD and CVD. It may also be used to address risk factors including high blood pressure, high cholesterol, and diabetes stated by Thomas *et al.* [1]. The slip velocity is the difference between the velocity of the air transmitted and that of the conveyed particles. The slip velocity can be used to calculate the blood velocity pipe geometry at the wall of the artery when a slightly higher blood velocity is chosen for the practical transfer of blood and solvent

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across an artery at a given rate. Nagarani and Sarojamma [2] stated that the study of blood flow in arteries with body acceleration is important in the diagnosis and treatment of diseases. In narrow arteries with a single mild axi-symmetric stenosis under body acceleration. The shear augmented dispersion of solute in blood flow through circular pipe and channel between two parallel flat plates with the effect of chemical reaction is investigated by Jaafar *et al.* [3], treating the blood as non-Newtonian of Casson fluid model. Das *et al.* [4] using Casson model to describe the dispersion of a solute in the flow of blood through a restricted artery with an absorptive wall, which is relevant to arterial pharmacokinetics. Rana and Murthy *et al.* [5] studied the transport of a solute in an unsteady blood flow in small arteries with and without absorption at the wall using Casson fluid model was suitable for blood flow in small vessels. The unsteady blood flow in the artery is observed from the systemic functioning of the heart and body acceleration to a pulsatile pressure gradient that rises. Lee [6] studied numerically the effects of steady flow through double similar symmetrical bell-shaped equivalent constrictions with percentage of restrictions of 33.3, 50 and 66.67 percent in tube for the Reynolds number in the range of 5-400, where the dimensionless restriction spacing is set as 1.0. Mandal *et al.* [7] investigated the impact of various bell-shaped stenosis structures on blood flow characteristics via the stenosis artery by considering various shapes at the inlet and outlet of the stenosis configuration. Debnath *et al.* [8] examined the effect of heterogeneous chemical reaction on the transport of a solute in a Casson fluid flow through an annular pipe under a periodic pressure gradient.

The research aims to study the dispersion of solute in Casson fluid with the effect of slip velocity and body acceleration through a bell-shaped stenosed artery. Objectives of this research are to formulate the mathematical model of Casson fluid model in a circular straight pipe and to solve momentum and continuity equation to obtain velocity of Casson fluid model. Unsteady convective-diffusion is solved to obtain the steady dispersion function using Generalized Dispersion Model (GDM).

Mathematical Formulation

The governing equations of equation motion, namely the momentum, constitutive and convective-diffusion equations are discussed.

Governing Equations

The momentum equation with body acceleration for steady flow is defined as Sankar and Lee [9]

$$\frac{1}{\bar{r}}\frac{d}{d\bar{r}}(\bar{r}\bar{\tau}) = \bar{F}(\bar{t}) - \frac{d\bar{p}}{d\bar{z}}, \tag{1}$$

where $\bar{\tau}$ is the shear stress, $\bar{p}$ is the pressure, $\bar{z}$ is the axial coordinate for a circular pipe, $\bar{r}$ is the radial coordinate and

$$\bar{F}(\bar{t}) = a_0 \cos(\varpi_b \bar{t} + \phi_1) \tag{2}$$

is the acceleration of the body, a_0 denotes the constant parameters of the pressure gradient, $\varpi_b = 2\pi\bar{f}_b$ is the circular frequency, $\bar{f}_b$ is the dispersion coefficient and $\bar{t}$ is the time and ϕ_1 is the lead angle of $\bar{F}(\bar{t})$ which relates to the heartbeat movement. The circular frequency is expected to be smallest, thus ignore the wave effect stated by Chaturani and Palanisamy [10]. The boundary condition of momentum equation Eq. (1) is given as follows:

$$\bar{\tau} = \text{ finite at } \bar{r} = 0. \tag{3}$$

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The constitutive equation of Casson fluid is given by

$$-\frac{d\bar{u}}{d\bar{r}}=\begin{cases}\frac{1}{\mu}(\sqrt{\bar{\tau}}-\sqrt{\bar{\tau}_y})^2 & \text{if } \bar{\tau}>\bar{\tau}_y,\\ 0 & \text{if } \bar{\tau}\le\bar{\tau}_y,\end{cases} \tag{4}$$

where $\bar{u}$ is the velocity of Casson fluid, μ is viscosity coefficient of Casson fluid model and $\bar{\tau}_y$ is yield stress. For the unknown velocity $\bar{u}$, with slip condition at the wall of the circular pipe and thus the slip boundary condition given by Sankar *et al*. [11] is as follows:

$$\bar{u}=\bar{u}_s \text{ at } \bar{r}=\bar{R}(\bar{z}), \tag{5}$$

where

$$\bar{R}(\bar{z})=\bar{R}_0\left(1-\frac{\bar{\delta}}{\bar{R}_0}\exp\left(-\frac{\bar{k}^2\bar{\varepsilon}^2\bar{z}^2}{\bar{R}_0^2}\right)\right), \tag{6}$$

where $\bar{R}_0$ represents the radius of the artery in outer region of the stenosis, $\bar{R}(\bar{z})$ is the radius of the stenosed segmen, $\bar{\delta}$ is the height of stenosis at middle point and $\bar{k}$ is the parametric constant and $\bar{\varepsilon}=\bar{R}_0/\bar{L}_0$. The principle of convective-diffusion are as follows:

$$\frac{\partial\bar{C}}{\partial\bar{t}}+\bar{u}\frac{\partial\bar{C}}{\partial\bar{z}}=\bar{D}_m\left(\bar{t}^2\frac{\partial^2}{\partial\bar{z}^2}\right)\bar{C}, \tag{7}$$

where boundary conditions of convective diffusion at the circular pipe center, $\bar{r}=0$ is

$$\frac{\partial\bar{C}}{\partial\bar{r}}(0,\bar{z},\bar{t})=0 \tag{8}$$

and at the wall,

$$\bar{r}=\bar{R}(\bar{z}) \text{ is } \frac{\partial\bar{C}}{\partial\bar{r}}(\bar{R}(\bar{z}),\bar{z},\bar{t})=0. \tag{9}$$

Non-Dimensional Variables

The following is the non-dimensional variables

$$\begin{aligned}
&C=\frac{\bar{C}}{\bar{C}_0},u=\frac{\bar{u}}{u_0},u_s=\frac{\bar{u}_s}{\bar{u}_0},u_m=\frac{\bar{u}_m}{\bar{u}_0},r=\frac{\bar{r}}{\bar{R}_0},r_p=\frac{\bar{r}_p}{\bar{R}_0},P=\frac{-d\bar{p}}{d\bar{z}},z=\frac{\bar{D}_m\bar{z}}{R_0^2\bar{u}_0},\\
&z_s=\frac{\bar{D}_m\bar{z}_s}{\bar{a}^2\bar{u}_0},t=\frac{\bar{D}_m\bar{t}}{\bar{a}^2},\tau=\frac{\bar{r}}{2}\left(\bar{F}(\bar{t})-\frac{d\bar{p}}{d\bar{z}}\right),\tau_y=\frac{\bar{r}_p}{2}\left(\bar{F}(\bar{t})-\frac{d\bar{p}}{d\bar{z}}\right),\\
&R(z)=\frac{\bar{R}(z)}{R_0},\omega_b=\frac{\varpi_b}{\omega},t=\omega\bar{t},A_r=\frac{a_0}{A_0},F(t)=\frac{\bar{F}(\bar{t})}{A_r},
\end{aligned} \tag{10}$$

where $\bar{u}_0$ is the fluid characteristic velocity, $C,u,u_s,u_m,r,r_p,P,z,z_s,t,\tau,R(z),\omega_b,A_r,F(t)$ and τ_y are the solute concentration, velocity, slip velocity, plug core radius, axial distance, solute length, time, shear stress, and yield stress in non-dimensional forms, respectively.

Method of Solution

Generalized Dispersion Model (GDM) is a derivative series expansion the approach of Gill and Sankarasubramanian [12] which is given by GDM for $C_m(z_1,t)$ as

$$\frac{\partial C_m}{\partial t}(z_1,t)=\sum_{i=1}^{\infty}K_i(t)\frac{\partial^i C_m}{\partial z_1^{\,i}}(z_1,t). \tag{11}$$

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The velocity expression in the outer non-plug core region is indicated as

$$\bar{u}(r)=\bar{u}_s+\frac{1}{4\mu}\left(\bar{F}(\bar{t})-\frac{d\bar{p}}{d\bar{z}}\right)\left[\bar{R}^2(\bar{z})-\bar{r}^2+2\left(\bar{R}(\bar{z})-\bar{r}\right)\bar{r}_p-\frac{8}{3}\sqrt{\bar{r}_p}\left(\bar{R}^{3/2}(\bar{z})-\bar{r}^{3/2}\right)\right], \tag{12}$$

where $d\bar{p}/d\bar{z}$ is the axial pressure gradient. Evaluating $\bar{r}=\bar{r}_p$ in the Eq. (12) the velocity of fluid in the plug flow region is obtained as follows

$$\bar{u}(\bar{r}_p)=\bar{u}_s+\frac{1}{4\mu}\left(\bar{F}(\bar{t})-\frac{d\bar{p}}{d\bar{z}}\right)\left[\bar{R}^2(\bar{z})-\bar{r}_p^{\,2}+2\left(\bar{R}(\bar{z})-\bar{r}_p\right)\bar{r}_p-\frac{8}{3}\sqrt{\bar{r}_p}\left(\bar{R}^{3/2}(\bar{z})-\bar{r}_p^{\,3/2}\right)\right]. \tag{13}$$

GDM is applied in convective-diffusion equation to obtain dispersion function longitudinal diffusion coefficient and mean concentration. The mean velocity is given by

$$\bar{u}_m=\int_0^{2\pi}\int_0^{\bar{R}(z)}\frac{\bar{u}\,\bar{r}\,d\bar{r}\,d\bar{\theta}}{\bar{r}\,d\bar{r}\,d\bar{\theta}}. \tag{14}$$

The dispersion function $f_1(r,t)$ plays an important role in calculating the deviation of the mean concentration $C_m(z_1,t)$. The whole process of dispersion is

$$f_1(r,t)=f_{1s}(r)+f_{1t}(r,t), \tag{15}$$

where $f_{1s}(r)$ is the dispersion function in the steady state and $f_{1t}(r,t)$ is the dispersion function in the unsteady state that describes the time dependent nature of the dispersion of the solute. In this study, the solution of steady dispersion function is crucial to observe the solute dispersion behaviour. The dispersion of solute which is low at the center and high when closes to the wall give improved consequences in the medicine since the solute can disperse to the artery wall quicker and efficiently. Therefore, the steady dispersion function $f_{1s}(r)$ is given as follows

$$f_{1s}(r)=f_{1s+}(r)=-\frac{1}{12}r_p^{\,3}+\frac{1}{12}BF(t)r_p^{\,3}-\frac{1}{672}\frac{r_p^{\,6}}{R^2(z)}+\frac{1}{672}\frac{r_p^{\,6}}{R^3(z)}+\frac{1}{48}\frac{r_p^{\,4}}{R(z)}$$
$$-\frac{BF(t)r_p^{\,4}}{48R(z)}+\frac{2}{21}r_p^{\,5/2}R^{1/2}(z)-\frac{2}{21}BF(t)r_p^{\,5/2}R^{1/2}(z)-\frac{1}{32}r_p^{\,2}R(z) \tag{16}$$
$$+\frac{1}{32}BF(t)r_p^{\,2}R(z)+CI,\quad \text{if } r_p\le r\le 1,$$

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$$f_{1s}(r) = f_{1s-}(r)$$
$$= -\frac{1}{12}r^2 r_p - \frac{1}{672}\frac{r^2 {r_p}^4}{R^3(z)} + \frac{1}{64}\frac{r^4}{R(z)} - \frac{1}{32}r^2 R(z) - \frac{8}{147}\frac{r^{7/2}{r_p}^{1/2}}{R(z)} + \frac{4}{21}{r_p}^{1/2}R^{1/2}(z)\log(r_p)$$
$$-\frac{1}{16}R(z)\log(r_p) - \frac{{r_p}^4\log(r_p)}{336R^3(z)} + \frac{\log(r_p)}{16R(z)} - \frac{4{r_p}^{1/2}\log(r_p)}{21R(z)} + \frac{1}{16}R(z)\log(r) -$$
$$\frac{r_p\log(r)}{6R(z)} - \frac{1}{6}r_p\log(r_p) - \frac{\log(r)}{16R(z)} + \frac{r_p\log(r_p)}{6R(z)} + \frac{4{r_p}^{1/2}\log(r)}{21R(z)} + \frac{{r_p}^4\log(r)}{336R^3(z)} +$$
$$\frac{1}{6}r_p\log(r) + \frac{2}{21}r^2{r_p}^{1/2}R^{1/2}(z) + \frac{1}{18}\frac{r^3 r_p}{R(z)} + \frac{115{r_p}^4}{28224R(z)} - \frac{4}{21}{r_p}^{1/2}R^{1/2}(z)\log(r) +$$
$$BF(t)\left(\frac{1}{12}r^2 r_p + \frac{1}{672}\frac{r^2{r_p}^4}{R^3(z)} - \frac{1}{64}r^4 + \frac{8}{147}\frac{r^{7/2}{r_p}^{1/2}}{R(z)} - \frac{1}{18}\frac{r^3 r_p}{R(z)} - \frac{115{r_p}^4}{28224R(z)}\right.$$
$$-\frac{2}{21}r^2{r_p}^{1/2}R^{1/2}(z) + \frac{1}{32}r^2R(z)\frac{1}{6}r_p\log(r) - \frac{{r_p}^4\log(r)}{336R^3(z)} + \frac{\log(r)}{16R(z)} -$$

$$\frac{4{r_p}^{1/2}\log(r)}{21R(z)} + \frac{r_p\log(r)}{6R(z)} + \frac{4}{21}{r_p}^{1/2}R^{1/2}(z)\log(r) - \frac{1}{16}R(z)\log(r) + \frac{1}{6}r_p\log(r_p) +$$
$$\frac{{r_p}^4\log(r_p)}{336R^3(z)} - \frac{\log(r_p)}{16R(z)} + \frac{4{r_p}^{1/2}\log(r_p)}{21R(z)} - \frac{r_p\log(r_p)}{6R(z)} - \frac{4}{21}{r_p}^{1/2}R^{1/2}(z)\log(r_p) + \quad (17)$$
$$\left.\frac{1}{16}R(z)\log(r_p)\right) + CI, \quad \text{if } 0 \le r \le r_p,$$

where CI is as follows:

$$CI = BF(t)\left\{-\frac{1}{12}r_p + \frac{{r_p}^6}{672R^5(z)} - \frac{{r_p}^2}{32R^3(z)} + \frac{2{r_p}^{5/2}}{21R^3(z)} - \frac{{r_p}^3}{12R^3(z)} - \frac{{r_p}^4}{672R^3(z)} -\right.$$
$$\frac{{r_p}^6}{770R^3(z)} + \frac{{r_p}^3}{12R^2(z)} - \frac{2{r_p}^{5/2}}{21R^{3/2}(z)} + \frac{1}{32R(z)} - \frac{2{r_p}^{1/2}}{21R(z)} + \frac{r_p}{12R(z)} + \frac{{r_p}^2}{32R(z)} +$$
$$\frac{47{r_p}^4}{14112R(z)} + \frac{2}{21}{r_p}^{1/2}R^{1/2}(z) - \frac{R(z)}{32} - \frac{7}{360}r_p R^2(z) + \frac{15}{539}{r_p}^{1/2}R^{5/2}(z) - \frac{1}{96}R^3(z)$$
$$-\frac{1}{6}r_p\log(r_p) - \frac{{r_p}^4\log(r_p)}{336R^3(z)} + \frac{\log(r_p)}{16R(z)} - \frac{4{r_p}^{1/2}\log(r_p)}{21R(z)} + \frac{r_p\log(r_p)}{6R(z)} + \frac{4}{21}{r_p}^{1/2}R^{1/2}(z) \quad (18)$$
$$\log(r_p) - \frac{1}{16}R(z)\log(r_p) + \frac{1}{6}r_p\log\left[R(z)\right] + \frac{{r_p}^4\log\left[R(z)\right]}{336R^3(z)} - \frac{\log\left[R(z)\right]}{16R(z)} + \frac{4{r_p}^{1/2}\log\left[R(z)\right]}{21R(z)}$$
$$\left.-\frac{r_p\log\left[R(z)\right]}{6R(z)} - \frac{4}{21}{r_p}^{1/2}R^{1/2}(z)\log\left[R(z)\right] + \frac{1}{16}R(z)\log\left[R(z)\right]\right\}.$$

Results and Discussions

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Velocity and Mean Velocity of the Blood Flow

The effect of stenosis, slip velocity, and body acceleration on velocity is graphically computed in this section. The results of velocity and mean velocity are obtained and discussed by fixing various parameters in the flow analytic expression after solving the momentum equation and defining the yield stress.

Figure 1 shows variation of velocity, u for different values of yield stress, τ_y in the blood flow with $A_0 = 2,\ \omega = 1,\ t = 1, \phi_1 = 0, P = 2,\ a = 1,\ b = 2.3, z = 3$ and $B = 2.5$. The existence of a stenosis inhibits blood flow in the narrow artery, resulting in yield stress changes. The increment of yield stress 0.1 to 0.5, the velocity decreases. As yield stress rises, the amplitude of velocity falls, allowing the plug flow to emerge. Yield stress is significant in viscoelasticity modification because it works as a path for human blood to circulate.

Figure 2 shows variation of velocity, u for different values body acceleration, A_0 with $\omega = 1,\ t = 1, \phi_1 = 0, \tau_y = 0.1, P = 2,\ a = 1, b = 2.3,\ z = 3$ and $B = 2.5$. The velocity increases when the body acceleration increases as the cross-sectional area narrows. The impact of body acceleration on blood flow is to increase flow rate while lowering artery resistance to flow. The body's acceleration has an effect on the average velocity and flow rate, lowering the body's acceleration. The body acceleration parameter has been discovered to play a significant role in blood flow, causing not only quantitative but also qualitative alterations in velocity profiles.

From Figure 3 illustrates variation of velocity, u for different values of slip velocity, u_s with $A_0 = 0,\ \omega = 1,\ t = 1,\ \phi_1 = 0, \tau_y = 0.1, P = 2,\ a = 1,\ b = 2.3, z = 3$ and $B = 2.5$. When slip velocity increases, axial velocity increases as well. Increasing of slip velocity lead to decreasing in flow resistance. Slip velocity plays a crucial role in blood flow modelling in a stenosed artery, according to Casson model. It's also possible to deduce that with slip, vessel wall damage could be reduced.

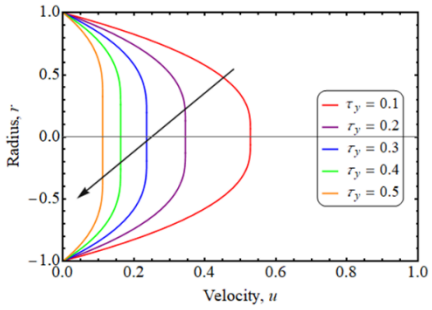

Figure 1:

Variation of velocity, u for different for values of yield stress, τ_y in the blood flow with body acceleration, $A_0 = 2,\ \omega = 1,\ \phi_1 = 0, t = 1, P = 2, a = 1, b = 2.3,\ z = 3$ and $B = 2.5$.

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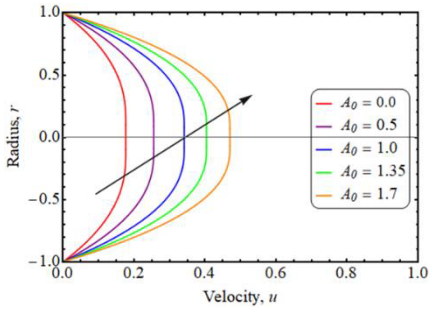

Figure 2:

Variation of velocity, u for different values of body acceleration, A_0 in the blood flow with $\omega = 1, t = 1,\ \phi_1 = 0,\ \tau_y = 0.1,\ P = 2, a = 1, b = 2.3,\ z = 5$ and $B = 2.5$.

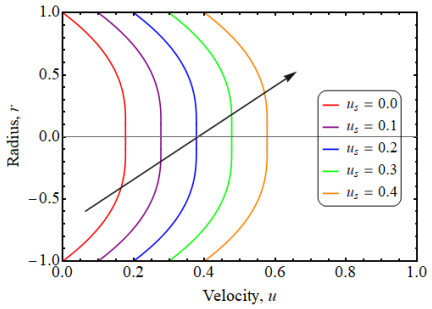

Figure 3:

Variation of velocity, u for different values of slip velocity, u_s in the blood flow with $A_0 = 0,\ \omega = 1,\ t = 1,\ \phi_1 = 0, \tau_y = 0.1, P = 2,\ a = 1,\ b = 2.3, z = 3$ and $B = 2.5$.

Steady Dispersion Function

The purpose of analysing the steady dispersion function in this study is to observe the changes of the steady dispersion function when the input of yield stress and body acceleration increases.

Figure 4 shows the variation of steady dispersion function, f_{1s} for different values of yield stress, τ_y in the blood flow with $A_0 = 0.5,\ \omega = 1,\ t = 2.8,\ \phi_1 = 0.02, P = 1,\ a = 0.01,\ b = 0$ and $z = 0.05$. When yield stress increases, the steady dispersion function decreases near the wall and opposite behaviour at the center of artery. Casson fluids are non-Newtonian fluids with a yield stress, making them ideal for narrow arteries. It is due to the flow rate of Casson fluids decreases as the viscosity of the fluid increases, and the value of the dispersion function decreases.

Figure 5 shows variation of steady dispersion function, f_{1s} for different values of body acceleration, A_0 in the blood flow with $\omega = 1,\ t = 2.8,\ \phi_1 = 0.01, P = 1,\ \tau_y = 0.01,$ $a = 0.01,\ b = 0$ and $z = 0.05$. The dispersion function increases as the amplitude of body acceleration increases at the center of artery and decreases in the outer region near the wall. As the amplitude of body acceleration increases, the blood flow drops, causing the dispersion function to decrease and the solute dispersion to be impacted by the fluctuating blood flow. With the increase of body acceleration, the amplitude increases, lowering the value of relative axial diffusivity in the blood flow.

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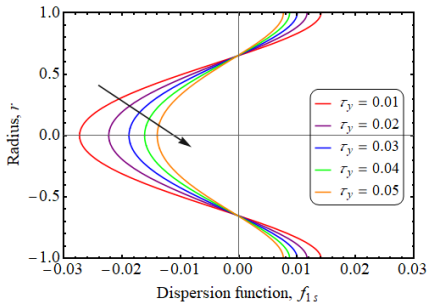

Figure 4:

Variation of steady dispersion dispersion function, f_{1s} for different values of yield stress, τ_y in the blood flow with $\omega = 1$, with $A_0 = 0.5$, $t = 2.8$, $\phi_1 = 0.02, P = 1$, $a = 0.01, b = 0$ and $z = 0.05$.

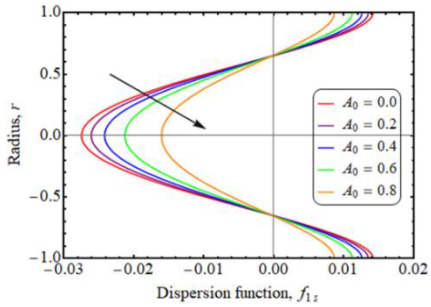

Figure 5:

Variation of steady dispersion function, f_{1s} for different values of body acceleration, A_0 in the blood flow with $\omega = 1, t = 2.8, \phi_1 = 0.01, \tau_y = 0.01$, $a = 0.01, b = 0, z = 0.05$ and $P = 1$

Conclusions

With the increase of body acceleration, the velocity increases as the cross-sectional area narrows. The impact of body acceleration on blood flow is to increase flow rate while lowering artery resistance to flow. The dispersion function increases, body acceleration increases at the center of artery and decreases in the outer region near the wall. The unsteady dispersion function grows as body acceleration rises. The value of the unstable dispersion function decreases when the radius enhances. It is noticed that the dispersion function increases with body acceleration increase and it approaches zero when the value of body acceleration keep increasing. As the height of the stenosis increases the velocity of the stenosis reduces then the artery becomes extremely narrow, then it is the reason the velocity decreases. Limitation in this research is the dispersion of solute in blood flow is solely investigated theoretically, not empirically. Another limitation of the study is no adequate experimental data is available and the results of solute dispersion cannot be compared to genuine data from earlier literature experiments. It is hoped that this study would help researchers to have better understanding about the behaviour of blood flow and dispersion of solute in blood flow, as well as provide insight into the issue of cardiovascular disease. The current findings are helpful in addressing the issue of dispersion in the cardiovascular system. This study helps doctors diagnose and treat cardiovascular disorders by observing blood flow characteristics. In future, to research can be extended to two Casson fluid model. It should also be noticed that the two-fluid blood flow model's velocity and flow rate are significantly higher than the single-fluid blood flow model's. Future to research also can be conducted on the experimental side on the real situation if the dispersion and diffusion of blood flow in arteries are known.

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Conflicts of interest
The authors declare no conflict of interest.

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THE RESEARCH OF COPYRIGHT PROTECTION IN NETWORK ENVIRONMENT IN CHINA

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Abstract: *Nowadays, we are in the network era. As we all know, the Internet is a double-edged sword. The same is true of the network copyright problem: on the one hand, its features, such as resource sharing and rapidity, have brought us a lot of conveniences; on the other hand, it is precisely because of these features that network copyright infringement incidents are shared, and new types of infringement are emerging. However, it is more challenging to deal with infringement cases due to the lag of legislation and the difficulty in defining the boundary of new copyright cases in the judiciary. In addition, the emergence of the Internet has increased the scope and strength of copyright protection. At the same time, the contradiction between public resource sharing and the safety of the interests of copyright subjects is also increasing. Therefore, to solve these problems, the article explores a new way of copyright protection under the network environment under the existing system premise to effectively protect the network works' copyright.*

Keyword(s): *Right of Information Network Communication, Copyright Protection, Copyright Infringement*

Introduction

The advent of the Internet era has seriously impacted the legal protection of traditional copyright. Although the network has the advantages of openness, paperless, and so on, which significantly facilitates the spread of the achievements of human civilization, at the same time, due to the virtual and fast nature of the network, copyright infringement continues to emerge. The network has changed how works are spread, so the manifestation of infringement has increased, making copyright protection more difficult. The old copyright system's regionality and uniqueness of copyright are experiencing significant difficulties due to variables like non-regionality and network information sharing. In this regard, a problem that countries urgently need to solve is how to effectively curb copyright infringement under the network environment and protect copyright owners' legitimate rights and interests.

Literature Review

As a part of intellectual property rights, network copyright is an essential product of modern scientific and technological progress and plays an essential role in promoting knowledge progress. Therefore, the legal protection of network copyright has become the focus of attention of all countries. At present, the legal protection of network copyright has made specific achievements, but the network, because of its own complexity, makes the network copyright protection more difficult, a variety of other new work infringements also continue to impact the traditional copyright legal protection mechanism (Yang Chunyu, 2019). The core resource of media is content, and the core of the content is copyright (Xu Shi, 2018). In addition, some scholars have come to a conclusion after studying the criminal protection of network copyright

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that there are some problems in the protection of network copyright in China, such as uneven distribution in regions and attaching importance to people. Still, despising punishment, imperfect protection system, etc (Liu Xiaoyu, 2020). Therefore, how to perfect the copyright protection system in China to cope with the challenges brought by the network era is worth exploring. To protect the copyright owner's copyright in time, a series of technical protection measures have emerged, which can achieve the purpose of prevention in advance and achieve a self-protection effect through individual authorization. Technical means have entirely cut off the possibility of illegal use of works and effectively solved the problem of lagging protection of intellectual property laws and regulations such as copyright law(Tian Xinxin, 2019). Some scholars pointed out that China can actively learn from the copyright management system of developed countries and promote the gradual optimization and improvement of organizational management mode and internal management system (Xie Shaodong, 2020). Experts suggest that the organization should ensure that it has independent legal person qualifications. In short, it can independently exercise the right of operation and management and the right of litigation (Fu Han, 2019). The power of collective management organization should be mainly derived from all copyright owners. Through the application of self-management and operation mode, the government should determine the organizational relationship and effectively avoid interfering in the formulation of the management system (Dou Yaping, 2004). The author believes that China's copyright protection laws are in progress, but its pace is challenging to keep up with the evolution of network copyright. Therefore, China can learn from the advanced experience of the United States and other countries to improve the level of the legal protection of network copyright and promote the healthy development of cultural industries.

Overview of Network Copyright

Definition of Network Copyright

In the 21st century, with the rapid development of Internet technology, network copyright, a new type of right, has also emerged. The carrier of this right is network works. Network works refer to creative works produced through the Internet and computer platform. Network works are different from traditional paper-based works. They only exist on the Internet and have the characteristics of originality and reproducibility. Accordingly, this kind of intellectual property right existing in-network works is called network copyright. Specifically, network copyright refers to the copyright enjoyed by the copyright owner in the network environment for the works protected by copyright law.

Specific Norms of Internet Copyright in Criminal Law

In the early stage of legislation, it is difficult for legislators to foresee the rapid development of network technology, so it is unclear what harm a network brings to copyright. As a result, the law did not make clear provisions for the infringement of network works. Until 2000, the Chinese law promulgated the decision on maintaining Internet security, which stipulates that anyone who infringes the copyright of others by using the Internet shall be investigated for legal responsibility in accordance with the relevant criminal law. Since then, China revised the copyright law in 2001, which stipulates that the copyright owner has the right to record his works and their contents and protect the rights and interests of the original author according to the information network tort law. The regulations on the protection of computer software adopted in 2002 and the protection of the right of information network dissemination adopted on July 1, 2006, have made relevant provisions on the criminal defense of the Internet and the rights and interests of information network dissemination.

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Characteristics of Network Copyright

No Region

One of the most apparent characteristics of network copyright is non -regionality, which is different from traditional copyright. Network copyright has no prominent regional protection characteristics. Because the international network is transnational, it isn't easy to judge in which field the copyright of works carried by the Internet should be practical and protected by the laws of each country. Therefore, there is no regional problem with network copyright.

Decreased Exclusivity

Because of the particularity of the network, the works spread through the network are efficient and universal. Still, at the same time, its exclusivity is significantly weakened compared with traditional copyright. In the network environment, most users only care about obtaining valuable work. Still, they need to learn who the copyright owner of the results is and the use conditions of the works, and they want to take the initiative to understand. Similarly, in the network environment, it is not easy for the copyright owners of the network works to understand the natural use of their works. Therefore, in the network environment, there is almost no proprietary work.

Digitization in The Form of Expression

Different from traditional works in their forms of expression, but with the emergence of "network hypertext structure," classic works have been digitized in the network, forming a new shape of work, the network works. The form of expression of network works has subverted the traditional meaning of distinguishing copyright types.

The Infringement of Copyright in The Network Environment

Characteristics of Copyright Infringement in Network Environment

Infringement Is Hidden

The network is a virtual world. Unless there are special requirements, few people on the network will use their real identities to log in to the website, and the same user may have multiple accounts. In contrast, several people may use the same signature simultaneously. Therefore, finding infringers in large-scale network copyright infringement is very time-consuming and laborious. The infringer has no sense of crime when committing the infringement, and even some infringement acts provide a great convenience for the public, so they are rarely condemned by society, and the punishment of the law is far less strict than other crimes. This is due to the misplaced evaluation of the morality of the virtual network space.

The Types and Ways of Infringement Are Complex and Diversified

Due to the network's virtual, technical, and geographical universality, the ways of network copyright infringement are complex and diverse, and the fields involved are countless. In the past, traditional text and picture works were the main infringed objects of copyright. The scope of the above-infringed things has gradually extended to film and television works and game software [Citation 2]. The cases also involve video-sharing websites, digital libraries, and other fields. All these bring significant challenges to the legislation and judicature of network copyright.

Non-Profit of Infringement Purpose

In the traditional sense, there are two necessary conditions for determining copyright infringement: the infringer should have subjective intention, and the other is to make profits.

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However, in the network environment, some network infringements are not necessarily for profit, and some may be out of curiosity or revenge. These acts have caused more severe consequences because of the power of the network. Therefore, it is difficult for the current law to investigate the responsibility for such non-profit infringement.

The Predicament of Copyright Protection in The Network Environment

Lack of Sound System

The infringement of copyright in the network environment mainly manifests in the following aspects: many infringers, fast infringement characteristics, wide distribution, diversified forms, etc. In the process of protecting the rights and interests of copyright owners based on the law, they also need to invest in substantial maintenance costs; At the same time, when copyright owners protect their copyright, they have high requirements for economic strength and professional knowledge. In this context, the collective management system of copyright came into being, which plays an essential role in complementing the rights of copyright owners. On the one hand, collaborative management involves comprehensive expertise, which is conducive to improving management efficiency; On the other hand, it is conducive to reducing the cost of rights protection and the difficulty of rights defenders' supervision. However, the Copyright Law of China has no specific and explicit content in the collective management mode, so there are still shortcomings in the practical operation, which makes protecting the collaborative management system of copyright challenging to be effective.

It Is Difficult to Determine the Jurisdiction of Infringement Cases

Due to the unique characteristics of the Internet and the sharing of network resources, the infringer can discreetly carry out the violation at any time and any place. It is precise because the network is virtual, we cannot find the corresponding residence on the network, and it is difficult to determine the nationality of the infringer and the exact location of each login. Therefore, the previous jurisdiction cannot be applied to the network environment. At the same time, because copyright infringement under the network environment is a collective action without an agreement, the infringers are often the unspecified majority. In this way, it may be difficult for the law to hold each infringing user accountable. Similarly, in this case, there will be multiple places of infringement or the defendant's domicile, which brings great trouble to the determination of the competent court in judicial practice.

Difficulty for Obligees To Provide Evidence Under the Network Environment

The evidence of network copyright infringement is mostly computer data, and it takes work to collect the evidence. Because the network information is changeable, easy to modify, and deletable, if the obligee does not obtain evidence in time, it may be impossible to get evidence later, or the evidence obtained is the evidence that has been modified. As can be seen, gathering evidence for online copyright infringement is more challenging than gathering evidence for traditional copyright infringement because the perpetrator may alter or destroy evidence before being held accountable or before investigators gather evidence. Even if the evidence is gathered without incident, verifying the evidence's integrity can be challenging. Therefore, obtaining proof of infringement has become a significant problem for network copyright owners to safeguard their rights.

The Economic Loss Is Unrecognition

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In the field of traditional copyright protection, it is challenging to identify economic losses, let alone in the area of Internet copyright protection. The court determines that the actual loss of the obligee and the infringer's illegal income generally calculates the infringement's economic loss. However, the substantial loss of the obligee requires the obligee to provide evidence. As mentioned above, it is difficult for the obligee to provide proof. Therefore, its claims cannot be fully recognized by the court, which ultimately leads to the fact that the amount of compensation for the infringer is far from the amount claimed, and the legitimate rights and interests of the network copyright owner are challenging to maintain.

Suggestions on The Protection of Copyright Under the Network Environment

Improving the Collective Management System

First, attach great importance to the full definition of the nature of the network copyright management organization. Based on the analysis of the nature of such organizations, the current common types in various countries are mainly non-governmental organizations and officially authorized organizations. The distinctive characteristics of copyright owners are embodied in the two aspects of individuality and decentralization. The network copyright management organization is fully embodied as the collective spokesman of copyright owners. At this point, eliminating the official administrative affiliation is necessary for the organization to fully and freely represent copyright owners. As a result, the organization's prominent members can only be non-governmental organizations. It should also make sure that it has a separate legal identity. To put it simply, it can exercise its management rights and litigation independently so that the phenomenon of copyright fighting alone can be effectively avoided, and then it can participate in the effective absorption of different copyright owners in various forms of membership so that the interests of different copyright owners can be uniformly protected.

Second, the power source of collective management organization is clear. Take the China Music Copyright Association as an example. To protect the legitimate rights and interests of more music copyright owners, the association's articles of association expand the source of executive power to make a practical breakthrough in protecting the original members. In short, the association will require users to actively pay royalties to music copyright owners who have yet to apply to join the association. As for the network copyright collective management organization, as the primary and unified subject of the exercise of the rights of the copyright owner and the performance of the obligations of the copyright owner, its rights should mainly come from all the copyright owners. Through the application of self-management and business models, the government can effectively avoid determining the organizational relationship and interfering in the formulation of the management system. Based on the analysis of the nature of copyright, the free exercise of this right is inseparable from legal protection. The copyright owner can use his copyright, which applies to the theoretical level as one of the legal principles. However, in the context of the continuous development of social relations, various conditions will restrict the exercise of personal power. From the perspective of the embodiment of this constraint in the collective management system of network copyright, it is based on personal power. Individual management should give way to collaborative management as the primary form of expression. In the face of this logical arrangement, the power source of the collective management organization should be based on the full respect of the will of the copyright owner. At the same time, when exercising collaborative management, it should also pay attention to the continuous optimization and improvement of the system content and exercise the power given by the copyright owner prudently and responsibly.

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Establish Punitive Compensation Mechanisms and Define Compensation Standards

Currently, our legislation needs a clear punishment standard, and it is challenging to deal with compensation cases in judicial practice. Therefore, it is imperative to establish a punitive compensation mechanism. A minimum threshold of compensation must be set up, and the court handling relevant compensation cases should determine the amount of compensation according to the standard of comprehensive compensation. That is, the infringer determined by the court should bear all losses caused by infringement. In addition, even if the beneficial obligee has not suffered any loss in judicial practice, it should also carry out some disciplinary and critical education for the infringer. It is not allowed to indulge in such infringement because the obligee has not suffered any loss, which will cause a terrible example to society. Therefore, the above minimum compensation limit can also be applied to this. In addition, because the infringer makes the obligee benefit from infringement, the punishment standard for the infringer should be lowered as appropriate, and the punishment standard should be formulated according to different geographical considerations.

Improvements in Technical Protection Measures

In recent years, with the continuous emergence of advanced information technology, the former fixed-place network environment has gradually shifted to mobile terminals. At this time, the traditional media, region, time and space, and other limitations in the copying and linking of network works have begun to break through comprehensively. The doubled transmission efficiency, a wide range of communication, and highly ignored costs have all provided great convenience for copyright infringement. Then the network's natural space-time and carrier barrier gradually lose under the network environment. At this time, to maintain the copyright owner's copyright in a timely manner, a series of technical protection measures have emerged. This protection means can achieve the purpose of prevention in advance and achieving the effect of self-protection through individual licensing. Technical standards completely cut off the possibility of illegal network work use. They effectively solved the problem of lagging protection of intellectual property laws and regulations such as copyright law [Citation 6]. With the continuous improvement of information technology, technical protection means are evolving and innovating. At this time, technical protection means not only including encryption methods but also new encryption means, such as electronic signatures and electronic watermarks, are gradually emerging. However, it is worth noting that, driven by interests and sabotaged by hacker organizations, new technology protection means have also been constantly attacked and cracked. At this time, once the technical protection measures established by the copyright owner are broken, copyright infringement will also occur. In this regard, when hearing copyright infringement cases under the network environment, the principle of the destruction of technical protection measures can be taken as one aspect in the process of determining the infringement.

Conclusion

The power of the computer network is growing daily, bringing convenience to all walks of life. There is no doubt, but there are also some drawbacks, especially since the impact on copyright is broader and more profound. From numerous cases of network copyright infringement in judicial practice, it can be seen that many copyright owners have suffered from violations of their legitimate rights and interests. Still, they are unable to protect their rights. It can be seen that it is imperative to protect the copyright of network works and ensure that the legitimate rights and interests of authors are not infringed. The corresponding laws and regulations are

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not perfect for the infringement of network works. Therefore, to better protect the network copyright, we need to formulate new rules and regulations based on the actual situation and strictly apply the law in judicial practice[8]. At the same time, we should continue to innovate, use network technology, strengthen people's awareness of network copyright, and protect the copyright of network works.

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PHP CRUD GENERATOR: A RAPID DEVELOPMENT OF WEB APPLICATION

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Abstract: *Developing a web-based system is crucial for any business or organization, particularly to better manage data and information. Users without programming experience must first learn and comprehend web development. It is not simpler to master but requires time and effort to comprehend fully. Additionally, the developer will require additional time to develop the prototype and present it to the client. Consequently, this study aims to design the prototype by implementing CRUD (Create, Read, Update, Delete) functions into the code using the System Development Life Cycle (SDLC) methodology. Initially, the requirements were gathered through interviews with prospective users, document collection, and observation. After gathering requirements, a prototype known as the PHP CRUD Generator was developed. An evaluation of the prototype's usability was conducted via field testing. According to the evaluation, most respondents were pleased with the task's simplicity and the time required to complete it. In addition, most respondents were pleased with and enjoyed using the PHP CRUD Generator. The study contributes to understanding the system and user interface requirements of the PHP CRUD Generator. It can also serve as a template for developers and researchers who want to create similar applications or learn how to create and manage CRUD functions more effectively.*

Keywords: *CRUD Generator, web application, CRUD reference model*

Introduction

CRUD is creating, retrieving, updating, and deleting, which refers to four major functions implemented in database applications. These functions are the user interface to databases and allow users to create, view, modify and delete data. CRUD works on entities in databases and manipulates these entities. However, the main problem is time constraints in developing the system, including implementing these functions. The user must learn about programming language and understand how system development works, such as data input, output and process between input and output. After mastering the language and how to solve the problem, they can implement them in their system. However, it takes time to understand this knowledge completely. Consequently, system development will be delayed and can cause problems as they may depend on the system.

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A developer must present the idea or solution for their customer once the requirements are known. It consumes time to build a prototype that includes CRUD functions during the design and development phases. Using PHP CRUD Generator as their prototype can reduce time, and they can focus on other features of the system. So, they can present their prototype and make the customer understand how the system works. So, they need to use the PHP CRUD Generator is an easy way to develop the system for CRUD functions.

Therefore, this paper bridges the gap by investigating the potential of a system to generate CRUD functions. This study aims to design the prototype of the PHP CRUD Generator by implementing the functions into the coding. As a result, PHP CRUD Generator, a prototype of a system for generating create, retrieve, update, and delete (CRUD) functions, was developed and evaluated.

The study contributes to understanding the system's web and mobile application requirements. It could be a reference model for developers and researchers to improve a generator for CRUD functions and develop a web application system through the generator. The next section describes the background and related studies. Next, the section describes the design and development of the PHP CRUD Generator. The subsequent section explains the usability evaluation of the PHP CRUD Generator. The last section of this paper concludes the study and lists future works.

Literature Review

This section describes the background and related studies investigating the importance of CRUD functions in the system and the process of CRUD. Next, this section discusses some similar systems related to this study and the similarities and differences.

Creating, retrieving, updating, and deleting (CRUD) are compulsory requirements in any system. These requirements enable the user to add new data/record, view, update and delete the selected data. The data is stored in MySQL Database like phpMyAdmin. Besides, Hypertext Preprocessor (PHP) is a server-side scripting language that is embedded in HTML. It manages dynamic content, databases, and session tracking and even builds entire e-commerce sites (Tutorialspoint.com, 2022). PHP helps to perform CRUD functions with communicating backend MySQL. So, the developers must implement the functions into any system when developing it.

Now, let's look at the process of CRUD works (Vengala, 2022). Firstly, create the name of the database and the tables involved in the database. Then, write an SQL query to insert data into the database. Next, write SQL query that is SELECT SQL Query to read the data, and it can filter results by using WHERE clause to read selected. It also can re-order the results in ascending or descending order. After that, write an UPDATE SQL Query to update the selected data in the database. Lastly, write DELETE SQL Query to delete data from the database.

However, the developers might face time constraints in completing the whole system. They should develop a system that meets user requirements. CRUD functions are the most requirements involved. A study believed that time pressure hampers creative work generally (Liikkanen, 2009). Every phase has steps or processes according to the work schedule. Sometimes, the developers cannot move to other phases because of miscommunications among the team members or other commitments such as personal matters or other tasks. Aftermath,

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they cannot complete the process in the phase due to time- consuming. It also delays the time to present the prototype to the user.

Furthermore, a study reported that the framework is a good choice for quick web application development and ensures it performs well (Nguyen, 2018)]. It can make web application development less work effort. Besides, developers can create functions and manage them based on user requirements. Generally, a PHP framework is an implementation layer of PHP, encapsulating some architectural patterns, principles and other implementations solving different problems (Samra, 2015). Some frameworks can help developers develop a system like xCRUD, Smart Forms, Laravel, and CodeIgniter. Furthermore, Marco described that software generators let developers focus on business logic, taking care of the basic operation and interfaces (Milano, 2016). It focuses on the idea that generated code must be as simple as possible to let developers easily modify it.

Here, there is a similar system that is related to this study. For example, phpGRID (phpgrid, 2022) is a tool that helps to build web applications, while CRUD Admin Generator (jonsegador.com, 2022) is an open-source tool to generate a complete backend from MySQL databases. However, both have similarities and differences in some respects (refer to Table 1).

Table 1. The Similarities and Differences Between Two System

	phpGRID	**CRUD Admin Generator**
CRUD (Select, Insert, Update, Delete) operations.	Yes	Yes
Integration with Modern PHP Frameworks	Laravel, CodeIgniter, Symfony, CakePHP, Yii2 and Zend Framework	Symfony
Major Relational Databases Support	MySQL, DB2, SQL Server, Oracle, Google Spreadsheets, Microsoft Access. SQLite and PostgreSQL	MySQL
Compatibility with Modern Browsers	Any Browser	Any Browser

Methodology

This study used System Development Life Cycle (SDLC) to develop a PHP CRUD Generator. SDLC is a series of main phases to create a hardware system, a software system, or a combination of both to meet or exceed customers' expectations (Frances, 2022). It comprises five phases: planning, analysis, design, development, and evaluation. This life cycle helps to build the system systematically. The flow of the phases is shown in Fig. 1.

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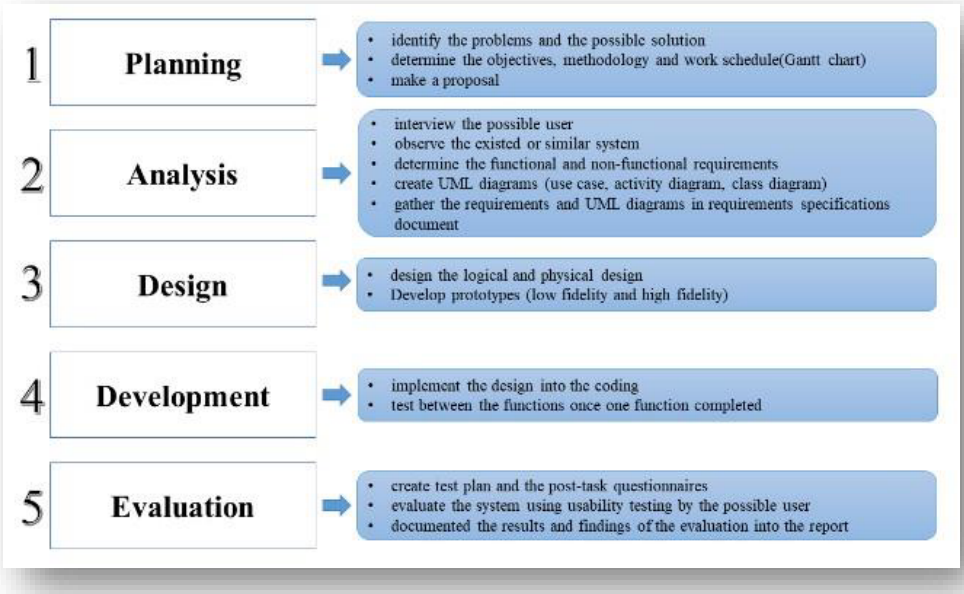

Figure 1. The Phases of SDLC

The first stage in the planning phase was to examine the system's feasibility. Then, we discovered the problem and listed the possible solution. Studied the existing system, gathered related information, and then determined the project background, objectives, limitations of the project, methodology, and Gantt chart. Lastly, write down all the information in the proposal.

During the analysis phase, the project's requirements were analyzed to meet the user's expectations and the requirements-gathering techniques needed to list all functional and non-functional requirements in the project. The requirements are determined by interviewing the possible user, gathering related documents, and observing. From the listed need, created a Use Case, model process, and model data. Then, the requirement gathered in the SRS document is used as input, and the software architecture used for implementing system development is derived.

The design phase included the project design based on the user requirements and detailed project analysis. The logical structure changed into a physical format with a detailed description such as input, output, databases, forms, codification schemes, and processing specifications. Low fidelity and high fidelity were also developed during this phase.

After designing, we implemented all the codes to develop the project and ensured its operations functioned well in the development phase. This phase also included usability testing to avoid any error or fault through the coding.

Once the coding was completed, evaluation and testing started, and the modules were released for testing. In this phase, the developed software is tested thoroughly, and any defects found will be fixed. Testing is done by real end-users or developers and gets feedback from them. Then, we demonstrated the final product of the project. After this phase, all information related to documents will be used as a reference in the future or for maintenance.

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Design and Development of PHP CRUD Generator

This section describes the design and development of a system for creating, retrieving, updating, and deleting (CRUD) functions. The section is divided into two sub-sections; the requirements of the system and the prototype development of PHP CRUD Generator, a system developed to demonstrate the gathered requirements. The requirements of PHP CRUD Generator.

The requirements were gathered by reviewing and analyzing the existing similar system with this study. Table II below shows the list of requirements of the PHP CRUD Generator. Every requirement has its priority, whether high (something the system must do) or medium (something the system preferably should do). Unified Modeling Language (UML) diagrams are developed based on requirements such as use case and activity diagram class diagram.

Table 2: List of Requirements of PHP CRUD Generator

No.	Requirement Description	Priority
	CREATE DATABASE	
1.	A new user must create the database before generating CRUD.	High
2.	The system must display a page allowing users to enter their database name.	High
3.	The system must save the database name and send a message about whether it is a success or failure.	High
4.	The system must display a page that allows the user to key in table(s) details: a) Table name b) Name attribute c) Type of attribute d) Length of an attribute	High
5.	The system must save all the table(s) details.	High
	GENERATE CRUD	
6.	The system must display a list of table pages, and the user shall select a table name to view.	Medium
7.	The system must display a specified table page with its record(s).	Medium
8.	The user shall add a new table record, view, update and delete a specified table record(s).	Medium
	Add / Create	
9.	The system must display a page that allows the user to key in table record(s) in its attributes.	Medium
10.	The system must save all the table record(s).	High
	View / Read	
11.	The system must display a page that view a specified table record(s) selected by the user.	Medium
	Update	
12.	The system must display a page that allows the user to update a specified table record(s) selected by the user.	Medium
13.	The system must save all updated table record(s).	High
	Delete	

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14.	The system must display a page that confirms the user to delete a specified table record(s).	Medium
15.	The system must delete specified table record(s) from its table in the database after the user clicks the button "Yes"	High

The use case shown was the interaction between the actor and the system of the PHP CRUD Generator. Use cases enabled understanding of the system though they do not fall too much in the implementation details. Moreover, activity diagrams showed workflows or object flows emphasizing the order and current conditions. Every action can be started if other actions are finished executing because objects and data become available or because some events are out of flow that goes on. Therefore, the figures below show the workflows involved in the use cases of PHP CRUD Generator (see Figure 2).

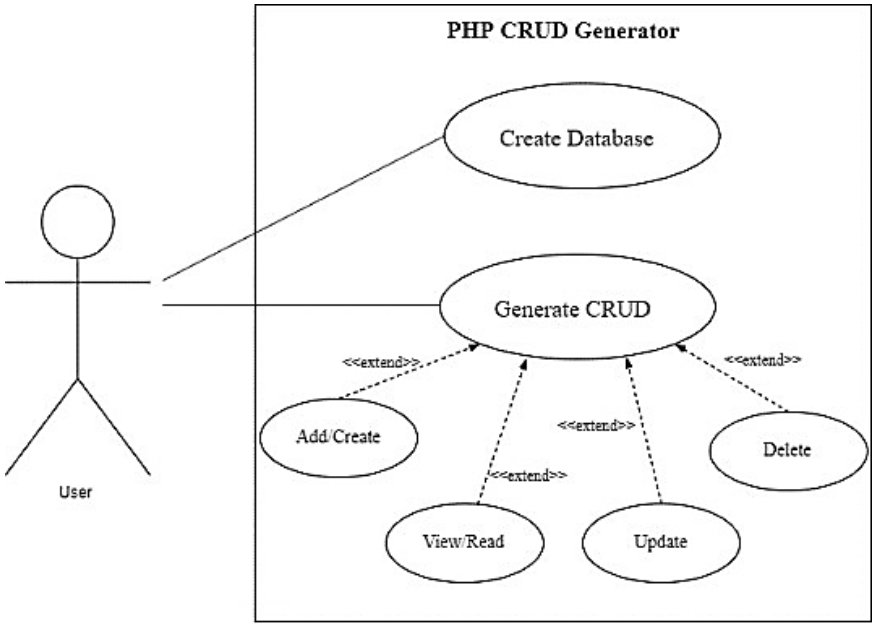

Figure 2: The Use Case of the PHP CRUD Generator

Evaluation of PHP CRUD Generator

A usability evaluation was conducted on 30 respondents, who were this study's possible end users. The respondents were approached randomly and invited to the online meeting, or they tested it themselves after downloading to test the PHP CRUD Generator. The two instruments used in the evaluation were the PHP CRUD Generator and the post-task questionnaire distributed to the participants through the Google Form link. The purpose of the questionnaire was to collect opinions from the participants on the interface, performance and usability of the PHP CRUD Generator.

It had two sections. The first was about Demography and Background Information, for the second section was about PHP CRUD Generator. This section is divided into usefulness, ease of use, navigation and hyperlinks and satisfaction with the PHP CRUD Generator. The procedure followed by the respondents was listening or reading the introduction to the PHP CRUD Generator, interacting with it and answering the post-task questionnaires.

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The Respondents' Demographic Information

The respondents' demographic information was analyzed. Among the respondents during the evaluation, 87% were female respondents, and 13% were male respondents. Besides, 97% of respondents were between 21 to 25 years old, and 3% were between 16 to 20 years old. 80% of participants had heard about CRUD functions created, retrieved, updated, and deleted; 10% of respondents had never heard, and 10% were unsure about it. 77% of the respondents have ever used any system with CRUD functions, while 13% never used it, and 10% were unsure about it.

The Usability of PHP CRUD Generator

The usability of the PHP CRUD GENERATOR was analyzed. It is divided into several aspects: usability, usefulness, and ease of use. The results of usability characteristics are shown in the graphs and tables below.

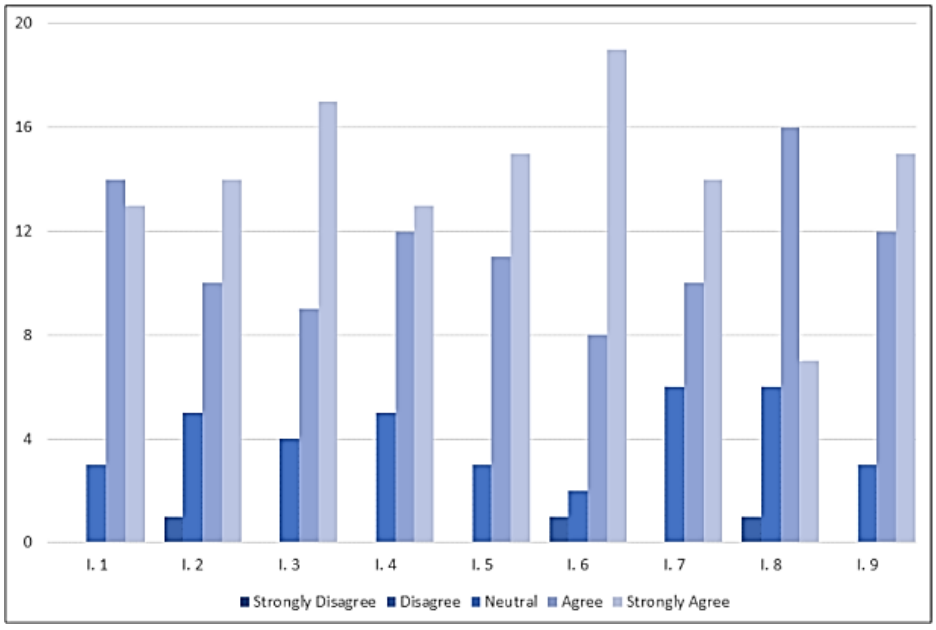

Figure 3: Usefulness

Table 3: The Usefulness of the PHP CRUD Generator

The usefulness of the PHP CRUD Generator							
	Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average
1.	PHP CRUD Generator enhances my effectiveness in accessing the system	0(0.0)	0(0.0)	3(9.0)	14(56.0)	13(65.0)	4.33
2.	PHP CRUD Generator increases my productivity	0(0.0)	1(2.0)	5(15.0)	10(40.0)	14(70.0)	4.23
3.	PHP CRUD Generator makes it easier to create a new system	0(0.0)	0(0.0)	4(12.0)	9(36.0)	17(85.0)	4.43
4.	PHP CRUD Generator gives me greater control over my work	0(0.0)	0(0.0)	5(15.0)	12(48.0)	13(65.0)	4.27

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5.	PHP CRUD Generator enables me to accomplish tasks more quickly	0(0.0)	0(0.0)	3(9.0)	11(44.0)	15(75.0)	4.27
6.	PHP CRUD Generator saves time when I use it	0(0.0)	1(2.0)	2(6.0)	8(32.0)	19(95.0)	4.50
7.	PHP CRUD Generator meets my needs	0(0.0)	0(0.0)	6(18.0)	10(40.0)	14(70.0)	4.27
8.	PHP CRUD Generator does everything I would expect to do	0(0.0)	1(2.0)	6(18.0)	16(64.0)	7(35.0)	3.97
9.	PHP CRUD Generator is useful	0(0.0)	0(0.0)	3(9.0)	12(44.0)	15(75.0)	4.27

Most respondents were satisfied with the ease of completing the task and the time it took. Based on the results, most respondents strongly agree that the PHP CRUD Generator meets their needs because they can create, read, update and delete the data. They also strongly agree that it is easy to use, whereas it shows the flow process starting from creating until generating it to the web application system.

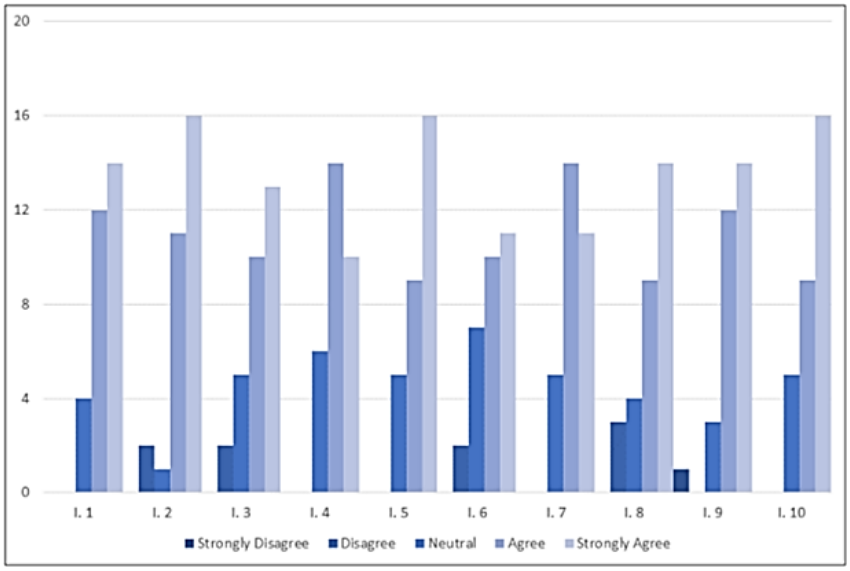

Figure 3: Ease of Use

Consequently, they strongly agree that PHP CRUD Generator does not open too many new browser windows when I am moving around if the respondents did not click any links or buttons. Moreover, most respondents were satisfied and pleased to use the PHP CRUD Generator.

Table 4: The Ease of Use of the PHP CRUD Generator

Ease of Use of PHP CRUD Generator							
	Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average
1.	PHP CRUD Generator is easy to use	0(0.0)	0(0.0)	4(12.0)	12(48.0)	14(70.0)	4.33
2.	PHP CRUD Generator is user friendly	0(0.0)	2(4.0)	1(3.0)	11(44.0)	16(80.0)	4.37

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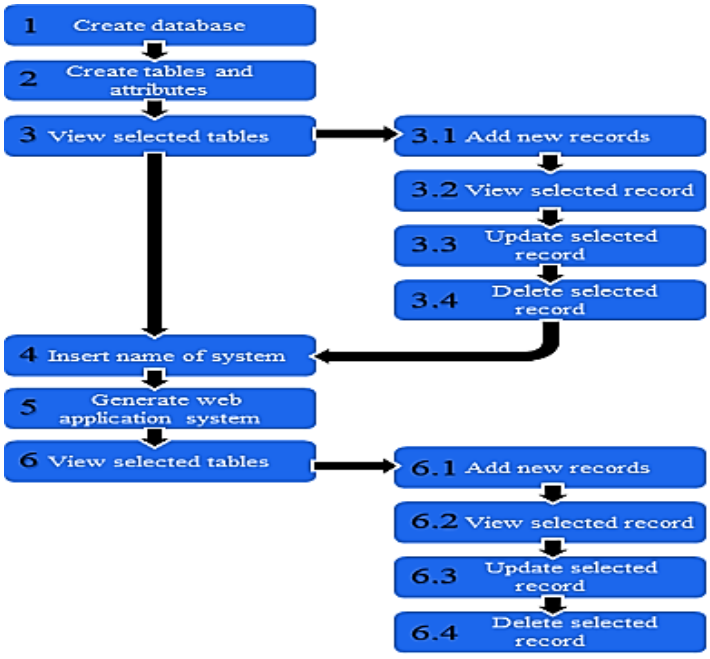
3.	PHP CRUD Generator is flexible	0(0.0)	2(4.0)	5(15.0)	10(40.0)	13(65.0)	4.13
4.	PHP CRUD Generator required fewer steps to accomplish what I want to do with the system.	0(0.0)	0(0.0)	6(18.0)	14(56.0)	10(50.0)	4.13
5.	PHP CRUD Generator is easy to learn how to use it.	0(0.0)	0(0.0)	5(15.0)	9(36.0)	16(80.0)	4.37
6.	I can use PHP CRUD Generator without written instructions.	0(0.0)	2(4.0)	7(21.0)	10(40.0)	11(55.0)	4.0
7.	I can easily remember how to use it.	0(0.0)	0(0.0)	5(15.0)	14(56.0)	11(55.0)	4.20
8.	I don't notice any inconsistencies as I use PHP CRUD Generator.	0(0.0)	3(6.0)	4(12.0)	9(36.0)	14(70.0)	4.13
9.	I can recover from mistakes quickly and efficiently when using PHP CRUD Generator.	1(1.0)	0(0.0)	3(9.0)	12(48.0)	14(70.0)	4.27
10.	I can use PHP CRUD Generator successfully every time.	0(0.0)	0(0.0)	5(15.0)	9(36.0)	16(80.0)	4.34

Conclusion and Future Work

This paper described developing a system to generate CRUD functions and become a web application system. In addition, it is a CRUD reference model to create a similar app. Figure 4 shows the CRUD model to explain the process of this study.



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In the future, this study can add more functionality and features to the system. Besides, this study also can add a template for the interface of the system where the user can choose any desired template. This study also can develop for mobile-based applications later.

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INFLUENCE OF THE AUDIENCE ON A SPEAKER'S SPEECH STYLE: A JOOSIAN ANALYSIS

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Abstract: *Speech style is a language variety that gives choices to an interlocutor to shift from one style of language to another. The primary purpose of this research is to discover the audience's influence on the speaker's speech style. Drawing upon the Joosian theory (1967), this research uses a qualitative conversational analytical approach to examine the selected sample. Two speeches by the same speaker to two different audiences have been used to examine their influence on the speech styles of the speaker. The result reveals that in his speech to the Pakistani audience, the dominantly used speech style is the consultative style. This is because the speaker gets a continuous response from the audience. In addition to this, as he is a native of Pakistan, so he feels a strong connection with the Pakistani audience which makes him more casual. The dominantly used speech style in the UN-General Assembly speech is formal. The reason is that he does not share a strong connection or bond with the Western audience. Furthermore, the speaker is addressing the Western audience as a Leader of his country, then transforms into the Ambassador of the Muslim World and finally as a Global citizen. So, he has kept his speech formal. Besides this, the researcher has also found additional features like coinage, name-calling, tone, repetition, aggression, and allusion. Furthermore, this data can be used to analyze other external factors that influence the speech style of the speaker.*

Keywords: *Language variety, Joosian theory, Coinage, Name-calling, Allusion*

Introduction

Speech style is a language variety that people adopt according to their different life situations. It makes the speech relevant and effective according to the context. For instance, one's speech style is different while communicating to a friend from the way one speaks to a teacher. Considering this phenomenon, Martin Joos (1967) proposed five categories of speech styles based on the degree of formality between the interlocutors. He made a comparison between various time zones and several speech styles. Just as people tend to change their clock when shifting from one time zone to another, people shift their speech style from one style of language to another according to the need of the situation. For instance, a casual speech style cannot be used while talking to a colleague as it will be considered impolite and unprofessional.

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Literature Review

Language and Language Variety

Human language has always fascinated researchers. Sapir (1921) treats it as "a non-instinctive method of human communication "that enables the speaker to share ideas, emotions, and feelings and argues that it cannot be learned naturally. On the contrary, Chomsky (2002) refers to language as an inherent ability.

Language variety is a collection of distinctive ways of expressing language. It is often referred to as isolect or lect. There can be variations in a language due to multiple factors: geographical (resulting in regional and social dialects); personal (idiolect); vocabulary (for a specific group or a profession). Furthermore, Richards and Schmidt (2010) identify sociolect which is a language variety restricted to a specific social class or educational background. Wardhaugh (2006) studies language variation as influence of external stimuli on human speech. Hudson (1996, p. 22) defines a variety of languages (as cited in Wardhaugh, 2010) as "a set of linguistic items with similar distribution" allowing Canadian English to be one variety, and American English as another variety.

Speech Style

Bell (1984) refers to the style as a response of a speaker to the target audience for whom one designs his speech. He further says that the primary reason for the shift from one speech style to another is determined by the social context. Coupland (2007) refers to style as the ways in which the speaker uses resources of language variation to create meaning in social settings. This means that the speaker adjusts his or her speech in a way that it is appropriate to the situation. Yule (2010) classifies speech style as the use of language formally or informally thereby identifying them as careful style/formal style and casual style/informal style. Failing to use the appropriate speech style concerning the situation or addressee results in facing embarrassment and awkwardness.

Style vs Register

In linguistics, there is a very thin line between registers and speech styles. People often use them interchangeably. Some linguists use the word "register" in place of style or speech style. However, Holmes (1992) deals with style at a much broader level depending on the addressee and context. According to Holmes (1992), style is the range of variation within the speech of an individual speaker that enables the individual to convey the same message in different ways depending on the context and the addressee. Similarly, Richard and Schmidt (2010) also recognize the influence of the audience on the speech style of the speaker with the addition of situation, location, and topic of discussion.

Contrarily, Richards and Schmidt (2010) define register as a specialized vocabulary for a group of people who have the same occupational background or people who share similar interests. Yule (2010) refers to registers as the conventional ways of using language, which is appropriate to a specific situational context, occupation, or topic.

In short, the major difference between style and register is that style is based on the degree of formality or familiarity with the addressee while the register is the specialized vocabulary for a particular group of people

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Martin Joos' theory of Speech Styles

Every person has a different style of delivering his or her utterances switching from one style to another, according to their relationship with the addressee or the situation in which they are communicating. It is vital to know what speech style should be adopted in a certain situation to avoid offense or awkwardness. Drawing upon analogy of different time zones, Joos (1967) identifies five speech styles which he refers to as five clocks: frozen style; consultative style; casual style; intimate style; formal style. The tabular representation of Joos' (1967) concept of speech style is given below.

Table 1: Joosian (1967) Concept of Speech Styles

Style	Occasions	Defining Features
Casual style	Friends; Acquaintances	Ellipsis; Slang
Intimate style	Spouse; Siblings	Extraction; Jargon
Formal style	Conference rooms; Assembly	Cohesion; Detachment
Consultative style	colleagues	Addressee's response; Supply of background information
Frozen style	Courts, Speeches, Ceremonials	Wise wording; Pre-planned

Methodological Framework

Sample and Sample Size

The selected sample consists of two speeches by Imran Khan that have been retrieved from YouTube. The first speech (SAMAA TV, 2019) was delivered at UN General Assembly and the latter (ARY News, 2022) was delivered at Karachi, Pakistan.

Sampling Technique and Tool

A purposive sampling technique has been employed for this study. The criteria for sampling are as follows: audience type (the audience type for the first speech is international audience while for the latter, it is local mostly consisting of youth); number of views (millions); duration.

Methodological Approach

The research is qualitative employing conversational analytical approach for comparing the chosen samples.

Analysis

Imran Khan's speech style at UN General Assembly (Speech I; Western Audience)

The following is the analysis of Imran Khan's speech style while addressing the Western audience. (SAMAA TV,2019).

Formal Speech Style

The following features of formal style, as given by Joos (1967), were found in the speech.

Speaker Authorized to Speak

The speaker begins his speech when he is authorized to speak, one of the defining features of formal style. He is invited to the podium by the speaker of the United Nations General Assembly to address the audience. These lines "*Assemblia cochanam on de korsam del primerminstro de la republica islamika de Pakistano, Sakhalin sia Imran khan. Pedo protocolo*

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co companyo Excelencia Tengo gran plaza de la moneda a senior tremor Ministro de la Republica yarmulke Pakistano on a given b talk a little say assembly a general" (0:01-0:42) introduce the Prime Minister of the Islamic Republic of Pakistan and invite him to deliver his speech.

Cohesion

The words uttered by the speaker, in the beginning, are highly cohesive, the speaker Imran Khan, begins his speech by following the sequence of rank in addressing the higher officials. Imran Khan begins by addressing, "*Mr. President, honorable Secretary General, Excellencies, and ladies and gentlemen" (0:48-1:01).* The utterances of the speaker have a proper sequence, first showing his gratitude for getting an opportunity to share his views on the world forum. Then he mentions the reason behind his presence by saying "*I want to talk about a lot of problems but just four today" (1:22-1:27)*.

Afterwards, he mentions the problem of climate change. He begins it with issues of climate change in his own country. The speaker elaborates on how climate change is rapidly getting worse and is affecting his country, Pakistan. He explicitly mentions, "*I will give you a start with my own country*" (2:32-2:36). As he starts with his own country, he mentions how Pakistan is being affected by climate change and if the situation continues, humans will face a huge catastrophe. He further adds his contribution toward the reduction of climate change. He says, *"we planted a billion trees in five years"* (3:54-3:56) and then adds *"now we have set ourselves a target of ten billion trees in Pakistan"* (3:57- 4:03). And, at the end, he mentions, *"This has to be combined effort of the world"* (4:12-4:18). The whole world "collectively" needs to work on it. The speaker follows a proper grammatical structure and a developing thought-sequence in uttering these sentences.

Thirdly, the speaker mentions his second point by saying, *"The second issue for me right now is"* (5:17-5:26). This utterance indicates that the speaker is about to mention another issue thereby connecting the second and the previous part together. This adds to the cohesion and building of coherence as well. It is also seen that the speaker mentions "Mr. President" multiple times. This indicates that the speaker is grabbing the attention of the President while talking about a crucial matter. The speaker ends his second point by clearly mentioning, *"So, this is my second point, I hope that the United Nations takes lead in this"* (10:01-10:08). It can be seen that the speaker has given a proper introduction, body, and conclusion to the second issue that he is addressing.

The speaker has also used logical cohesion by mentioning the corruption of richer countries resulting in the failure of the developing world. He first mentions different types of corruption prevailing in the global society. Then he adds the consequences of corruption on the poorer countries. The speaker does not talk about a single country, instead, he categorizes these countries as rich and poor. The logical connection between the words, especially money laundering, corruption, drug money, and terror financing is highlighting the linguistic feature of formal style, creating and building cohesion.

The speaker, then, discusses the third point of his speech which is Islamophobia. He says, *"My third point is"* (10:22-10:26). This connects the previous issues with the third point. He has used an allusion, here, to 9/11 which is referring to the historical event. He says, *"Islamophobia since 9/11 has grown at a pace where it is alarming"* (10:42-10:31). He clearly says, *"My point*

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here is that we must address this issue." (13:24-13:29). By using "must" he indicates that the issue of Islamophobia is compulsory to be addressed. And, by using "My point", he states the purpose of talking about the third issue which is Islamophobia.

The speaker, again, introduces the next theme before talking about it. He says, "Now the number fourth point is" (23:49-23:52), thus introducing the topic this way gives the audience insight into what is coming next. He explains to the audience the rise of terrorism and how Pakistan supported the United States in its war against Afghanistan. He connects all these points with the Kashmir issue. The reason behind giving this detail was to make it clear that Pakistan is not involved in any kind of terrorism and to highlight the brutality against Kashmiris.

All the four stages, and its ideas are organically well connected. The speaker has elaborated and well connected all four points. He makes it easy for the audience to comprehend his 50 minutes speech into four points. His utterances are semantically and lexically well-structured making it a cohesive text. It is semantically well structured because each sentence is logically connected, and it is giving a proper sense and meaning. Similarly, lexically, it is well connected because the vocabulary used is giving a logical meaning to his utterances.

Detachment

The speaker Imran Khan, very respectfully, addresses the President and other members of the audience by using the word "honorable". The speaker says he is "honored" to be there. He also shares the reason for his physical presence at the forum which is to draw the attention of world leaders towards substantial matters by pointing out and stating, "urgent problems that the world *mus*t address". By using *must,* the speaker emphasizes that whatever he is going to talk about is of substantial importance.

The speaker makes use of factual percentage-based evidence to make his speech compelling for the audience. He says, *"80% of our water comes from rivers"* (2:57-2:58). Instead of targeting a specific richer country, he talks about all countries, including Pakistan, which are contributing to the greenhouse gases. He mentions the contribution of his country towards the reduction of global warming by first planting *"a billion trees in five years"* (3:54-3:56) and then setting up a target of "*ten billion trees"* (4:01). Then he requests the world to make collective efforts to eliminate global warming. which means that collectively humans can bring change. He also mentions "*richer countries must be pushed"* (4:52-4:54), which means that the richer countries that are contributing more to the greenhouse gases should work on a solution. Finally, he says that the "United Nations must take leadership in this" (5:12-5:15). This utterance indicates that he is emphasizing the fact that the United Nations must lead the countries in solving the global issue of climate change.

The speaker, Imran Khan, then talks about the second issue which is how rich countries are becoming richer and poor countries are becoming poorer *(5:20-10:20)*. It is because corruption is prevailing in these developing countries. The speaker is talking about debt of the developing world that has increased in the previous years due to corruption. He is detaching his personal feelings about the corruption of previous parties in Pakistan and gives evidence of corruption and lack of resources in his country. The seriousness of his words is invoking apprehension among the people. He asks multiple times the rich countries that they "must" take action against the corrupt members who are taking the money out of the country and are buying foreign lands

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for their interests. Without signaling out any a party or individual, he respectfully, draws the attention of the audience towards money-laundering and other corrupt activities of previous rulers of Pakistan.

The third issue that he points out is that of Islamophobia, without naming any nation or leader who had banned the hijab in their countries, thereby successfully avoiding to create a division between himself and the audience. He speaks on behalf of all Muslims of the world. He ends talking about the issue of Islamophobia by saying, *"we must address this issue"*. This shows that this is a serious issue that needs serious attention. The speech elaborates on how Islamophobia is increasing and is affecting Muslims and how it can worsen. The speaker uses words like *marginalization*, *radicalization*, *militants*, and *Islamophobia* to show the seriousness of the situation. Instead of harshly criticizing the Muslim leaders for not addressing this issue, he very respectfully mentioned, "We Muslim leaders have not discussed this issue either". Instead of blaming anyone he has used the pronoun "we", thereby taking responsibility. He blames the Muslim world along with himself by stating, "We in the Muslim world did not explain to the West that there is no such thing as radical Islam" (14:54-15:03). By saying so, he is pointing out the weakness of the Muslim Leaders including himself, without naming anyone.

The speaker then moves to the issue of Kashmir. He gives instances of the wars his country has had with India over Kashmir. The speaker mentions that his aim as a Prime Minister was to bring peace to his country. He explains with facts and figures that seventy thousand people in Pakistan died during the war against the Soviets. He gives detailed accounts of the events which makes the audience convinced. When he is talking about his rule in Pakistan, he does not use the pronoun *I,* instead he uses *we*. For instance, when he says, "We came to power, we decided that we would dismantle what was left of these groups" (27:10-27:19) even though *we* show personal involvement. However, the speaker uses *we* employ contribution, as a Prime Minister, in diminishing terrorism.

Lastly, he talks about how Mr. Modi has deprived the Kashmiris of their basic human rights. By putting facts and figures in his speech, he makes his speech more elaborate and catchier. The speaker talks about the Rashtriya Swayamsevak Sangh (RSS), the Hindutva-based organization and its brutality. The speaker says, "hundred thousand Kashmiris were denied the right given by the United Nations". The speaker, on behalf of all human beings, talks about the rights of Kashmiris. He also adds, "material prevails over humans" referring to being a huge business market that no human rights organization is talking against. The speaker grasps the attention of the audience by choosing his words wisely and by adding mathematical figures and numbers to his speech. The speaker has used a formal speech style to impact the audience. Interestingly, the speaker detaches himself from the audience and connects himself to the people outside the forum. Firstly, the speaker is seen as a spokesperson of his government and party when he talks about planting a billion trees; secondly, he becomes an ambassador of Pakistan when he talks about the role of his country in the reduction of global warming; thirdly, he is an Ambassador of Muslim world while addressing the issue of Islamophobia and lastly, he is seen as a global citizen when addressing the Kashmir issue.

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Frozen Speech Style

The defining features of frozen speech style were also found the details of which are given below.

Choosing Words Wisely

The speaker starts his speech by uttering, "So, first of all, I start with climate change" (1:49-1:51). This shows that the speaker has given a good start to his first issue. He knows that the Western audience is concerned about the environment, so he begins his speech with a topic that is close to the heart of his audience. He, then, says there is a "lack of seriousness" about the climate issues instead of using a negative term. Subsequently, this made his standpoint as a Prime minister effective.

Secondly, when he is explaining the fact that there is no radical Islam, he claims that if a Hindu is involved in a suicide attack, people do not blame the whole religion. So, he does not talk badly about other religions and expects the same treatment towards Muslims. He chooses his words wisely, keeping in mind that other religions should not be offended. He further adds that as he was a former cricketer, he had spent most of his life in the West. He says that he understands the Western psyche, so without blaming a specific individual he states he blames "some" Western people who would create something that would malign the prophet Muhammad, (peace be upon him). The speaker is aware of the presence of the Western audience, so instead of naming any country or person, he is very respectful towards them and uses the word "some". The speaker then further elaborates what teachings Islam preaches. Furthermore, his tone is serious, purposeful, respectful and civil.

In another instance, the speaker straightforwardly announces that the world should not use the freedom of speech to cause pain to the Muslims by insulting their Holy Prophet Muhammad (Peace be upon him) *(23:40-23:47)*. The speaker uses the word "insulting" to show the pain that the West is causing to the Muslim world. This also makes the audience realize the effect of these words. He also uses the pronoun "us" to show the audience that he is talking on behalf of the whole Muslim community.

Pre-Planned

The speaker, intentionally, starts his speech with a global issue so that the audience stays alert during the speech. Here the speaker grabs the attention of the audience by mentioning a substantial matter which needs immediate attention. As the speaker has got a chance to address the whole world, he has planned these points to clarify a lot of misunderstandings. He knows he is being heard by the President and Global Ambassadors, so he is choosing such words that do not offend anyone, nor do they target a specific individual group. He mentions that he always wanted to clarify the image of Islam and wanted the people to know what Islam teaches. He sums up this point by saying, "I always imagined what I would say and educate the world about Islam if I ever stood on this forum."

Lastly, it is pre-planned because he mentions in the beginning that he is there to discuss four points. So, this shows that the speaker has previously planned what things he will discuss once he gets to the world forum. It is preplanned and the beauty of his speech is in that he starts with a global issue moving towards corruption and its role in the light of developing world countries, Islamophobia and Indo-Pakistan issue of Kashmir. He then links the imminent threat of a nuclear war with global warming thereby sending a very strong wake-up call throughout the

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world. This intelligent plan immediately catches the attention of the general global population and creates a sense of care, concern, and urgency in the audience.

Consultative Speech style

The following are the features of the consultative speech style found in Speech I (Western Audience), given by Joos (1967).

Addressee's response

Consultative speech style is a semi-formal way of uttering a sentence. By saying "Killed about ten trees" (31:27-31:29), Imran Khan has brought the element of humor into his speech. As a reply to his utterance, the audience applauded him. This applause is a response to the utterance of the speaker. The speaker also personifies trees and sensitizes the audience so as to influence them to raise their voice against the people who are harming the environment. Even though the setting is very formal, the speaker has uttered these sentences in a consultative style.

Supply background Information

Additional to the audience's response, the speaker needs to supply background information. The speaker talks about the Prime Minister of India, Mr. Modi, for concealing the truth with the lie that they have killed terrorists in Pakistan. He explicitly shares, "The entire campaign, almost the entire campaign of Mr. Modi in the election was how he had taught Pakistan a lesson" (31:11-31:20). Throughout the speech, the speaker provides background information to each point. When he talks about Islamophobia, he also gives the background of how Islamophobia emerged.

While discussing Islamophobia, he shares the reasons behind the creation of such a division. Without pointing out a specific leader, the speaker respectfully mentions that "certain" Western leaders equate Islam and the hijab with terrorism and gives the reference to 9/11. His words are simple yet powerful. He does not use a difficult lexicon which would create confusion among the audience. The speaker purposely kept his speech simple so that the message could be delivered effectively.

Casual and Intimate Styles

The features of casual and intimate style were not found in Speech I.

Imran Khan's Speech style in Karachi, Pakistan (Speech II; Local Audience)

The following is the analysis of Imran Khan's speech style while addressing the Pakistani audience in Karachi, Pakistan (ARY News, 2022).

Formal and Frozen Styles

The features of formal and frozen styles were not found in this speech.

Consultative Speech Style

The following Joosian features of consultative style were found in Speech II (Local Audience).

Addressee's Response

The speaker begins his speech by reciting a few verses of the Holy Quran and thanks the people of Karachi for their presence. The people are chanting and applauding the speaker, which shows the response of the audience. The speaker explicitly mentions that he is there for "*baat*

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cheet", an Urdu word for chit-chat. He then asks the audience to raise their hands to say whether his ousting from the office of the Prime Minister of Pakistan was a conspiracy or an interference. In response to this, the crowd raises their hands and agrees to the point that it was a conspiracy.

The audience, throughout the speech, responds with applause or by moving the flag of Pakistan and that of Tehreek-e-Insaaf. For instance, when he says "*apne in zameer farosho ko kabhi maaf nahi karna" (23:32-23:38), the* audience hoots and shouts, which indicates that they are agreeing to what he is saying. In another instance, he says, "*imported hakoomat*" (23:03-23:04) to which the audience replies "na manzoor"; he adds further "*awaz nahi arahi*"(24:08-24:09) which means they are not loud enough, and again says "*imported hakoomat*" to which the audience this time replies loudly "*na Manzoor*"(24:10)[1]

Secondly, the audience also responds by clapping or by yelling in support of the speaker. When the speaker says "*me kisi kisam ka apne mulk ko nuqsan nahi dekhna chahta . Na kia hai aur na kabhi ham Insha Allah hone dainge" (51:14-51:20).* In response to this, the audience claps and shows their support for what the speaker is advising them to do.

Finally, when the speaker asks the audience**, "***aap tayar hain election k liye?" (53:14-53:16),* the audience responds by hooting in agreement.

Supply Background information

The speaker first tells the audience the reason behind arranging the procession (political gathering). He says that the issue he wants to share with his audience is going to affect the future of the people of Pakistan and the future of their children. First, he clears his stance that he is not against any country by saying, "na *me Anti-Indian hun , na me Anti-European hun, na me Anti-American hun"* (3:23-3:35). Then he uses the allusion *Mir Jafar* by saying "*Ek Mir Jafar ko hamare uper musalat kardia hai" (*5:48-5:54). Being aware that his audience generally consists of the youth, he shares the details of the historical figure named Mir Jafar, the person his act of selling He calls the new Prime Minister "Mir Jafar" and says he has been forced on Pakistan as a result of foreign conspiracy, thereby referring to his ousting as result of foreign hands.

Furthermore, he tells the people that he knows the European countries better as he has spent more time with them as compared to other politicians. He says, *Aap jab apne mulk ki diffa karte hain, apne mulk k mafadat k liye stand laite hain , wo aap pe pressure zarur dalte hain, lekn wo apki izzat karte hain (21:18-21:32) .* This shows that he understands the psyche of Europeans and he is letting the audience know that by taking the stand they will gain more respect. He also mentions NRO (National Reconciliation Ordinance), which was given by General Musharraf to the ex-Pakistani leaders, Nawaz and Zardari. He shares that General Musharaf had a major contribution to the suffering of Pakistan. By supplying this background information, he is making people aware of the consequences Pakistan would face for having a corrupt Prime Minister who is appointed with the help of foreign conspiracy.

[1]The hashtag analyzed by the Tweet Binder in the favor of Imran Khan and against his ousting have been the biggest trend with a total of "106,433,419" tweets.

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At the end of the speech, he says **"**Hamne hamesha pur aman ahtijaj kia hai" (50:47-50-53). Reminding the people of the previous protests of Tehreek-e-insaf. He gives a background to the youth that Tehreek-e-Insaf has always been involved in peaceful protests and they would not let anyone disturb the peace. He also tells the audience that he will not bear any kind of harm to his nation, Pakistan.

Casual Speech Style

The following features of casual style, as pointed out by Joos (1967) were found in Speech II (Local Audience).

Slang

At times, the speaker seems as if he is addressing a friend. The speaker says, **"**Acha *jee han me diesel pe araha hun abhi, diesel pe araha hun" (8:49-8:54).* The word *diesel* has been used for Molana Fazal Rehman, a politician. In the speech, when the speaker utters these words, people who are not familiar with this term might think the speaker was referring to the substance "diesel". But as the Pakistani audience is familiar with the term, Diesel for a corrupt politician known for his corruption through diesel, they chant and applaud. Normally a person would not expect an Ex-Prime Minister to use such slang for the opposition leaders in a formal speech, but as the audience and the speaker consider each other as insiders, no one objects to the usage of such words. The speaker further says, "*hamare 20 member of Parliament, unke zameer jaag jate hain, unko ek dam pata chalta hai k oho Tehreek e insaf to buri hai" (12:53-13:04).* In this example, he uses *oho* which is a slang expression.

In another example, the speaker uses the word Janab, which has been used as a slang word in Urdu Language. He says, **"***abb yahan jhoot bol k k janab bara bemar hai marne wala hai" (39:28-39:31).* Throughout the speech, it can be observed the speaker is talking very casually to the audience as if they are his friends. The way the speaker is narrating the past events is very informal. He says *"phir ye hua"* and *"phir wo hua"*. The words he chooses "chor, mafia, mar raha ho" show the casualness of his speech.

Ellipsis

The speaker uses ellipsis multiple times. He says *"hamne diesel ki kimate niche ki thi, ye ab apke diesel ki kimate barhane wale hain"(8:54-9:01).* Instead of mentioning who the speaker uses the pronoun *ye* very informally they as he expects the audience to understand who he is referring to. The speaker, at many instances uses the pronoun "*ye*" instead of mentioning *who*. In the example, it can again be noticed that he uses the word "*ye*" instead of repeating the name. "*Amerika me hamare ambassador ki mulakat hoti hai official Donald Lu k sath, aur ye sunne ye kia kehta hai, Pakistanio sunne ye kia kehta hai" (10:11-10:24).* Instead of repeating the person's name the speaker uses *"ye"*.

Moreover, at times the speaker does not provide background information as he expects the audience to understand his.When he talks about Nawaz Sharif, the audience knows who he is talking about. The speaker says "Udhar *jo master mind tha is sari sazish ka, London me baith k jo ye sari sazish karaha tha" (39:05-39:14).* The speaker does not mention the name of the person he is talking about as he expects the audience to understand. He uses the word *isne* instead of using the name. He says, "*Musharraf k dor me isne muaidah karke Saudi Arabia bhaag gaya" (39:23-39:28).*

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Intimate Style

The features of intimate style were not found in the speech as this style is used among very close relations.

Results

The analysis shows some Joosian and some non-Joosian features of style which were found in the text.

Table 2: Joosian Features of Speech Style in The Two Texts

Speech Styles	Speech I (Western audience)	Speech II (Local audience)
Formal Style	a) (a) Speaker Authorized to Speak Detachment • Spokesperson of Government • PTI (his party) • Pakistan • Muslim Community • Global Citizen b) (b) Cohesion • Lexical Cohesion • Grammatical Cohesion • Semantic Cohesion	None of the features of Formal Speech Style are found that are given by Joos.
Frozen Style	a) (a) Wise use of wording The speaker uses wise and decent words to deliver his speech. b) (b) Pre-planned It is pre-planned because the speaker, in the beginning shares, he is here to discuss four issues.	The speaker pre-plan the issues he is there to discuss. However, he is not careful with his words. As he uses the technique of name calling.
Intimate Style	None of the features of Intimate Style are found in the speech.	None of the features of Intimate Style are found in the speech.
Consultative Style	a) Addressee's response "Killed about ten trees" (31:27-31:29) to which the audience applauds. b) Supply background information The speaker provides detail for all the four issues he discusses	a) Addressee's response *"Imported hakoomat" (23:03-23:04*) to which the audience replies "*na manzoor"* "*apne in zameer farosho ko kabhi maaf nahi karna" (23:32-23:38),* the audience hoots and shouts. "*aap tayar hain election k liye?" (53:14-53:16),* the audience hoots and cheers. b) Supply background information The speaker gives detail account of every issue he mentions.

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Casual Style	None of the features of casual style are found that are given by Joos (1967).	(a) Slang *Janab; oho; acha jee* (b) Ellipsis *Isne; ye*

Table 3: Non-Joosian Features

Speech I	Speech II
Religious Beginning The speaker begins his speech with the remembrance of Allah Almighty (00:40-00:46) and in the name of Allah, the Almighty.	Religious Beginning Bismillah Hir Rahman Nir Rahim, Iyya ka na buddu wa iyya ka nastaeen (0:01-0:13). In the name of Allah, humility to one God and seeking his help.
Tone/ Vocabulary He uses the titles "Mr." with the President and "honorable" with the Secretary-General making the tone and the vocabulary respectful.	Tone The tone of the speaker is sometimes serious and sometimes casual.
Distinctive Vocabulary (a) Strong Words *Oppression*, *cruelty, Crush the people of Kashmir*, *butchered* (b) Coinage The speaker uses the word *boxten* (c) Pinpointing "RSS" members as "goons" Mr. Modi -narrative of "Islamic Terrorism"	(a) Allusion "Mir Jafar Hampe bhi Musalat kardia" Mir Jafar was an Afghan traitor. (b) Aggression It can be observed in his speech when he talks about the oppression on the Kashmiri Muslims.
Self-Correction/Repair "We are scared that there we are, *humans* are facing a huge catastrophe (3:42-3:46) The entire campaign, *almost* the entire campaign of Mr. Modi in the election was how he had taught Pakistan a lesson" (31:10-31:20)	Repetition "Ye jo sazish hoi hai, ye jo sazish hoi hai, ye apko Ghulam rakhne ki sazish hoi hai" (5:35-5:45)
Setting UN-General Assembly	Name-Calling *Lota*, *jo lota huai the*, *cherry blossom boot polisher*, *chor mafia*, *mastermind*, *takatwar daku* , *Sharif Mafia*, *diesel*

The above table shows non-Joosian features that were found in the two speeches that contribute to the speech style of the speaker. The speaker, in the first speech, is seen having a very respectful tone. In addition to this, self-correction is seen multiple times. He says, "The entire campaign, *almost* the entire campaign of Mr. Modi in the election was how he had taught Pakistan a lesson" (31:10-31:20) So, first he says the entire then immediately corrects himself by saying "almost the entire". This is because Mr. Modi's campaign had other objectives and agendas as well. It will be nonfactual to say that the entire campaign of Mr. Modi was about their attack on Pakistan. So, the speaker realizes this and instantly adds the word *almost*.

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Moreover, the speaker coins the word "*boxten*" to refer to the Kashmiris of Indian occupied Kashmir who are caged at their homes. In the second speech, the speaker uses the technique of name-calling (table 3). Additionally, he repeats phrases to emphasize them, and the tone of the speaker is sometimes serious and at times casual. Another feature used is, an allusion to Mir Jafa whereby, he is calling the current Prime Minister Mr. Shahbaz Sharif as Mir Jafar.

Similarities Between the Two Speeches

The two speeches showed some similarities with respect to speech styles. The similarities have been tabulated below followed by their description.

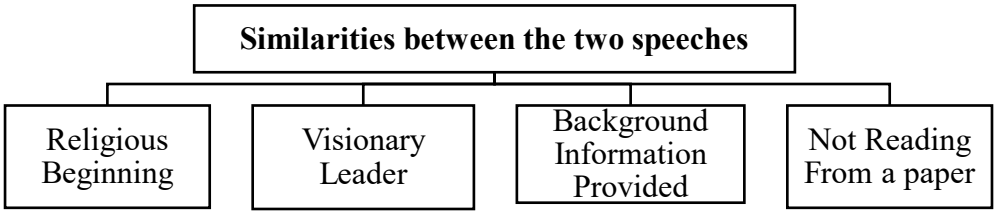

Figure 1: Similarities Between Speech I and Speech II

The speaker begins both his speeches by reciting verses from the Quran. In addition to this, the speaker is seen to be a visionary leader in both speeches. In the first speech, the speaker is first seen as an individual shifting places to be the spokesperson of his party and the country (Pakistan) then the Ambassador of the Muslim World to be followed by being the ambassador of the world. Similarly, in the second speech, he talks to the audience as a leader of Pakistan. Another similarity in both speeches is that the speaker provides background Information on all the points and issues that he discusses. Lastly, the speaker does not read from a paper while delivering his speeches. Even though he has pre-planned the points, he speaks from his heart and does not read from a paper.

Differences Between the Two Speeches

The two speeches were found to be different in some respects that are tabulated below.

Table 4: Differences Between the Two Speeches

Speech I (Western Audience)	Speech II (Local Audience)
Dominantly used Style is the Formal Speech Style.	Dominantly used style is the Consultative Speech Style.
The technique of Name-calling is not used	Name-Calling has been used
Self-Correction/Repair	Absence of Self-Correction/Repair

In the first speech, the speaker mostly used the formal style as the speech is delivered in a formal setting. In addition to this, he does not share a close bond with the Western audience, so he is seen being formal. On the other hand, in the second speech, the speaker mostly used a consultative speech style as the audience is more involved and there is a continuous response at the audience's end. Secondly, technique of name-calling has not been used in Speech I (Western Audience) as the speaker knows the audience will not accept it as the setting is formal. In Speech II (Local Audience) as he is a native of Pakistan, he feels a close bond with the Pakistani audience, and he knows he can speak his heart out. He is using the language of his

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youth that follows him. So, he knows he will not be judged for using those names (table 3). Thirdly, the speaker self-corrects himself in the first speech to avoid ambiguity, to stay factual, and to avoid offending the Western audience. Whereas, in the second speech, there is the absence of self-correction as the audience is his people and they understand his points without any judgment.

Conclusion

In conclusion, it was found that the audience does influence the speech style of the speaker. Although both speeches are delivered by the same speaker, there is a big difference in the speaker's speech style with the change in audience. As the speaker is a native of Pakistan and he feels like an insider, he has been more casual with the audience in Speech II (Local audience). On the contrary, he does not share such a bond with the Western audience, so he can be seen as being formal. In addition to this, the speaker, in some instances, rephrases his words while addressing the Western audience. This is because he keeps his utterances more factual, as well as he does not want to offend the audience by using certain words. On the contrary, when he is addressing the Pakistani audience, he does not need to rephrase his words as he is a native of Pakistan and he is addressing his people. This indicates that when a person is addressing an outsider, one is more watchful of one's words.

The Western audience consists of senior and high government officials, the speaker has maintained mainly a formal speech style. The Pakistani audience consists of people around all age groups, but due to his strong connection with them, he is more casual. He has explicitly thanked the children, the families, and the women for being there and for taking a stand against the foreign conspiracy. As he has a bond and connection with Pakistani audience, the speaker has dominantly used the consultative speech style while the speaker does not share a such personal connection or feeling with the Western audience, so the formal speech style was dominant during his address at the General Assembly. As the selected sample is political speeches, so the technique of name-calling was found in the Pakistani speech.

Recommendations

The present research has mainly focused on the audience's influence on the speech style of the speaker. Moreover, only two speeches are taken as a sample to study the phenomenon. The work can also be used to examine the influence of the setting or environment as well as the influence of the topic of discussion on the speech style of the speaker. It can also be applied to other genres. As some additional features of style were found in the speeches, these non-Joosian features can be used to analyze more speeches of different genres for proper validation.

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MARKETING VIA SOCIAL MEDIA: ARE MALAYSIAN CONSUMERS LEGALLY PROTECTED AGAINST THE SO-CALLED 'MIRACLE PRODUCTS'?

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Abstract: *Social media marketing uses interactive websites such as Facebook, Instagram, Twitter, and the like to socialise while building brands, promoting products, and interacting with potential customers. The ability of a single thread to go viral in a very short period makes social media marketing so effective. It allows brands and sellers to engage with a vast amount of consumers in ways that most large businesses traditionally could not. However, unlike conventional advertising, law enforcement has limited control over the contents and flow of messages generated via social media platforms. Laws designed to govern traditional forms of advertising may not be appropriate to govern the new wave of advert, creating legal uncertainties in the social media marketing context. Additionally, those promoting products via social media platforms may or may not be aware of the enormous legal risks associated with their online activities. Some may have a 'material connection' with the business by receiving incentives to promote products, making legal liabilities secondary concerns. Consumers may find it challenging to make informed decisions in a social setting. They may have difficulty distinguishing between honest endorsement and paid marketing, thus making purchases against their true preferences. This study examines relevant laws that shield consumers against the so-called "miracle products", including false nutritional claims (e.g., can treat and cure terminal diseases) as well as misleading and exaggerated claims (e.g., height growth supplements). Legislations studied include but are not limited to the Food Act 1983, Medicines (Advertisement and Sale) Act 1956, Consumer Protection Act 1999, and Trade Descriptions Act 2011. The study contends that law enforcement has yet to address the issues accordingly, leaving Malaysian consumers susceptible to health-related product fraud. This study adopted doctrinal and comparative methodologies to validate the hypothesis. It analyses statutes, decided cases, and journal articles while examining approaches in the United Kingdom against advertising via social media marketing. The findings are hoped to provide insights for legislative and non-legislative reforms in Malaysia and raise awareness of the legal impacts of misleading and deceptive advertisements via social media platforms among relevant stakeholders such as sellers, businesses, and consumers.*

Keywords: *Health-related Products; Legal Implications; Misleading and Deceptive Advertisement; Social Media Marketing*

Introduction

The internet has changed the way businesses market their products and services. In recent years, social media have outperformed traditional advertising channels such as television, radio, and newspapers (Belanche, Cenjor, & Pérez-Rueda, 2019, p. 72). Marketers are quickly shifting from conventional advertising methods, e.g., via television, newspapers, radio and

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magazine, to digital platforms such as social media. Consequently, people gradually devote more time to the internet than traditional media (Johan, Zain, Miura, Mcxin, & Annuar, 2022, p. 141). Consumers favour social media ads over conventional media, such as newspapers, because the former is less expensive. Consequently, consumers spend more time on social media than ever before, thus exposing them to a wide range of advertisements (Johan et al., 2022).

The total population of Malaysia as of January 2022 was 32.98 million. Out of this figure, the number of social media users was 30.25 million, equivalent to 91.7% of the total population. Interestingly, Figure 1 revealed that 54.7% of Malaysians visit social networks to seek information about brands and products. This data indicates that social networks are the most popular means of assessing information.

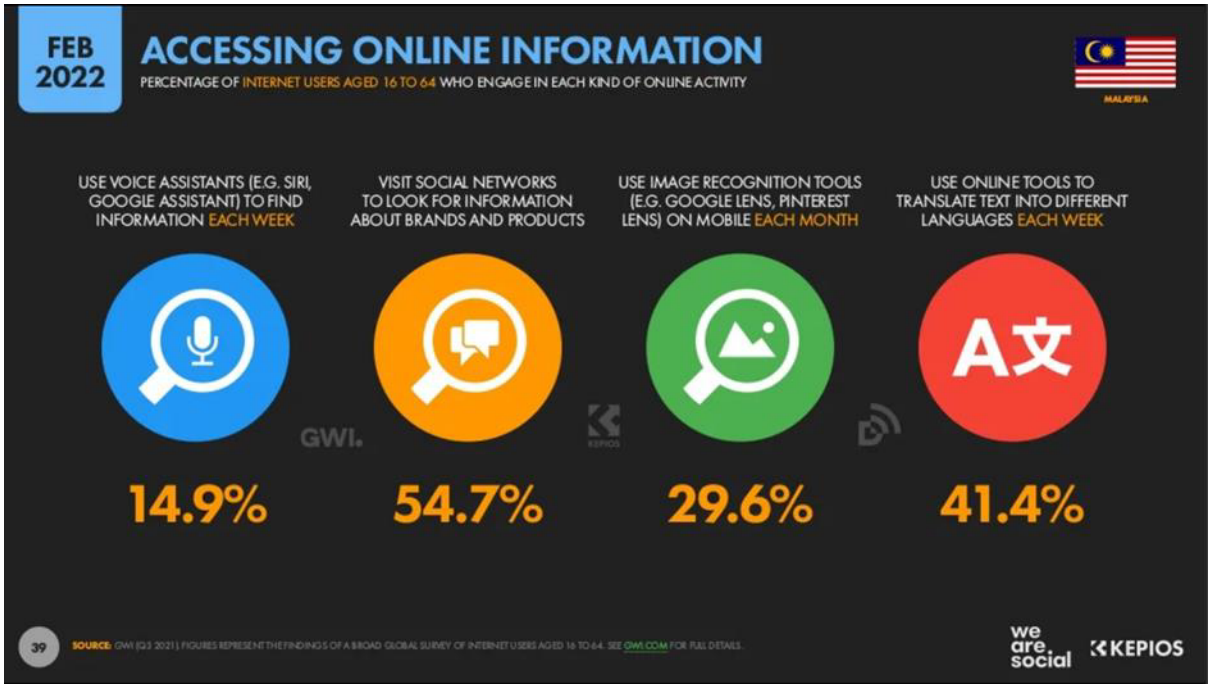

Figure 1: Percentage of Internet Users Aged 16-64 Engaging in Online Activity
Source: (AsiaPac Net Media, 2022; Kemp, 2022)

Figure 2 shows that as of February 2022, social media marketing has been the core of digital marketing in Malaysia (AsiaPac Net Media, 2022; Kemp, 2022). For example, 44.1% of respondents acknowledged that their primary motivation for using social platforms was to see what was being discussed. This may include products that are going viral. Similarly, 40.5% and 37% of respondents use social media to look for things to do or purchase, which may include both goods and services. 31.9% of the respondents also used social media to share opinions about goods and services. Consumers might find their reviews about products more reliable than the brand itself since the endorsements came from consumers too.

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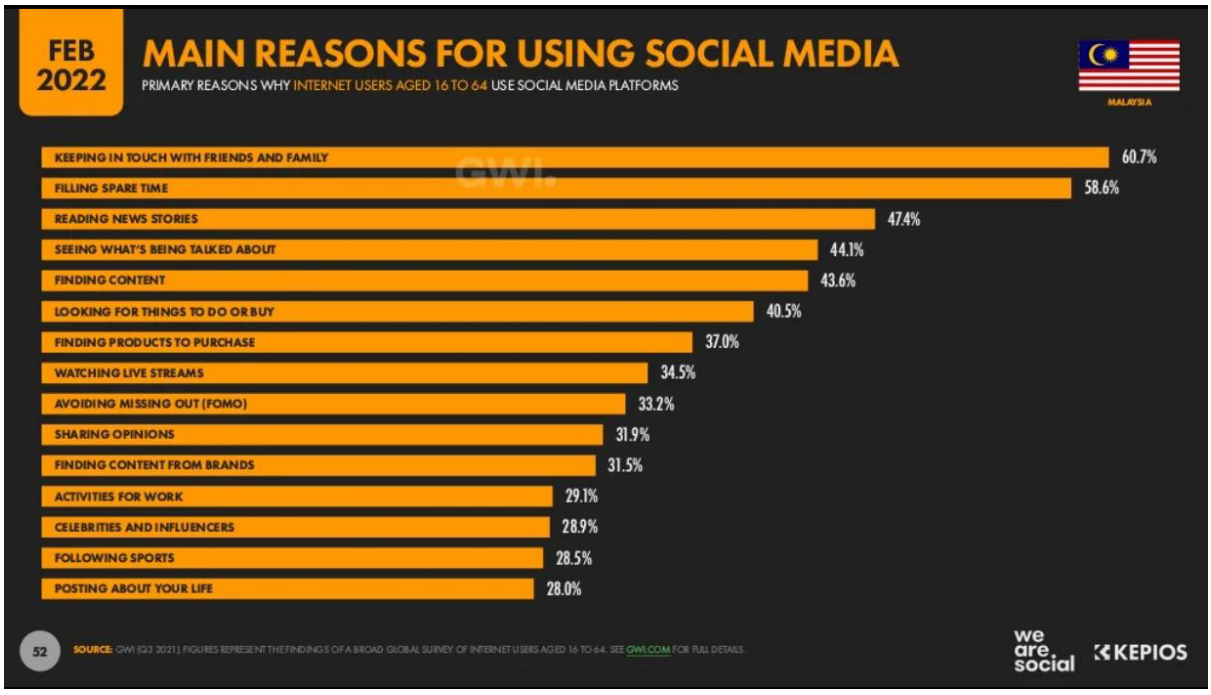

Figure 12: Main Reasons for Using Social Media

Source: (AsiaPac Net Media, 2022; Kemp, 2022)

Research Objectives and Questions

This study argues that law enforcement has yet to address the issues accordingly, leaving Malaysian consumers susceptible to health-related product fraud. To validate this hypothesis, the study aims to:

i. examine the regulatory framework governing marketing via social media in Malaysia; and
ii. propose appropriate legislative and non-legislative reforms to the existing legal framework governing social media marketing in Malaysia.

In light of these objectives, this study intends to analyse whether the law enforcers in Malaysia had effectively governed the deceptive marketing issue in the context of social media settings.

Methodologies

This study adopted doctrinal and comparative approaches. Doctrinal research identifies, analyses and synthesises the law. It critically examines the key features of the legislation and case law whilst summarising relevant elements to establish a correct and complete statement of the law on the issue at hand (Watkins & Burton, 2018, p. 13). Meanwhile, a comparative analysis is an intellectual activity with laws as its object and comparison as its process (Zweigert, Kötz, & Weir, 1998, p. 2). Comparative analysis also engages in studying the law but does not limit itself to the interpretation of laws within one system but examines several systems simultaneously, side by side (Husa, 2011, p. 209)

Literature Review

While social media platforms are primarily used for social interaction, many people and businesses use them to sell goods and services. This scenario is known as social commerce

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(Riefa, 2020, p. 281). Social commerce has blurred the lines between transactional and social environments. In particular, the social aspects make identifying the parties (e.g., consumers, sellers, influencers) more difficult, posing a challenge to the application of consumer law (Riefa, 2020). Secondly, people nowadays obtain health information from official government health websites and social media platforms (e.g., Facebook, Instagram), thanks to the internet's broad reach. This can be problematic for users who blindly trust the information on social platforms without verifying its accuracy (Faizol & Maso'od, 2020). Concerns about the quality and reliability of online health information should not be ignored because they may significantly impact the individual's well-being and the public's health (Faizol & Maso'od, 2020). Thirdly, gullible consumers are easily swayed by claims made in advertisements, which may result in losses and jeopardise their health and well-being (Abdul Aziz, Mohamed Isa, Mhd Salle, Abu Bakar, & Saripan, 2020, p. 327). Fourthly, the community is increasingly following the medical advice of social media influencers. Nonetheless, many people are unaware that most social media influencers lack a medical background, which may lead to them providing misleading information to the public (Faizol & Maso'od, 2020). Lastly, several studies have shown that social media marketing impacts consumers' purchasing process, which explains why they are so prevalent nowadays. However, not all jurisdictions have the tools necessary to regulate this marketing practice. This is primarily because soft law, or even legislation, is only sometimes effective at detecting the commercial nature of certain content (Riefa, 2020).

Discussion

Medicines (Advertisement and Sale) Act 1956

Section 2 defines 'advertisement' to include any notice, circular, report, commentary, pamphlet, label, wrapper or other document and any announcement made orally or by any means of producing or transmitting light or sound. Any advertisements of medicines must be approved by the Medicine Advertisements Board (section 4B). The Act has firmly banned ads that lead to the diagnosis and use of the article as a medicine or remedy to prevent or treat the disease (section 3). The diseases specified in the schedule include but are not limited to Cancer, Tuberculosis, Diabetes, Asthma, kidney defects and infertility. The Act also prohibits advertisements relating to skills or services. Simply put, one should not take part in advertising skills or services relating to the treatment, prevention or diagnosis of any ailment, disease, injury, infirmity or condition affecting the human body. This prohibition also includes inducing any person to seek advice from the advertiser or person referred to in the advertisement. Those found guilty of these offences will have to pay a fine not exceeding RM3000 or face imprisonment of not exceeding one year, or both. For a subsequent conviction, the Act imposes a heavier fine of RM5000 and imprisonment not exceeding two years or both (section 5). Regrettably, ads contrary to prohibitions under section 3 are still prevalent on social media (e.g., Facebook), which among others, are as shown in Figures 3 to 5 below.

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Figure 13: Advertisements Related to Tuberculosis

Figure 14: Advertisements Related to Cancer

Figure 15: Advertisements Related to Asthma

Food Act 1983

The Act governs advertisement or representation by any means whatsoever that directly or indirectly promotes the sale of other disposals of any food (section 2). Foods include those that are manufactured, sold or represented for use as food or drink for human consumption (section 2). In particular, a product classified as food may not claim to prevent, treat, or cure disease or other physiological conditions. Food with medical claims must first be registered with the Malaysian Drug Control Authority, Ministry of Health Malaysia (MyHEALTH Kementerian Kesihatan Malaysia). Advertising false, misleading and deceptive labelling in regard to the character, nature, value, substance, quality, composition, merit, safety, strength and origin, to name a few, would lead to imprisonment not exceeding three years, fine or both (section 16). If the food advertised contains poisonous and harmful substances or is injurious to health, the person involved will be liable to a fine not exceeding RM100,000, imprisonment not exceeding ten years or both (section 13).

Consumer Protection Act 1999 (CPA)

This Act broadly governs every form of advertisement be it spoken, written or sound, by way of notices, catalogues, price lists, circulars, labels, cards or other documents or materials. Advertisement also includes the exhibition of films, pictures or photographs by utilising radio, television, telecommunication or other similar means (section 3(1)). Sections 9 and 10 of the Act provide for the offence of misleading conduct and false or misleading representation. In particular, conduct, representation or practice is ‘false’, ‘misleading’ and ‘deceptive’ if such practices can lead a consumer into error (section 8 (a)). These offences are punishable under section 25.

Trade Descriptions Act 2011 (TDA)

Section 2 defines ‘advertisement’ similarly to the CPA, except that it explicitly addresses electronic advertising. Besides, this Act also prohibits false and misleading statements about

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goods and services (section 18). The aspects considered in assessing false and deceptive representations of goods and services are practically identical to the CPA (TDA, sections 6,7,16(1) and CPA, section 10). A body corporate contravenes with the prohibitions risks fine not exceeding RM500,000 and a fine up to RM1,000,000 for a second or subsequent offence. Meanwhile, a person will be subject to a maximum fine of RM250,000 or imprisonment for less than three years or both. A second or subsequent offence will result in a fine not exceeding RM500,000, imprisonment not exceeding five years or both (section 21).

Comparative Observations

In the United Kingdom (UK), the key legislations governing consumer law include Consumer Right Act 2015 (CRA), Consumer Contracts (Information, Cancellation and Additional Charges) Regulations 2013 (CCRs) and Consumer Protection from Unfair Trading Regulations 2008 (CPUTRs). These legislations were enforced by the Competition and Markets Authority, the Local Authority Trading Standards Services and Advertising Standards Authority (ASA). The CCRs and the CRA make it mandatory for traders to provide material information clearly and comprehensively before consumers place orders. Whereas the CPUTRs prohibit traders from engaging in three types of unfair practices related to information. These prohibitions are misleading actions (e.g., providing false information), misleading omissions (e.g., omitting or hiding material information) and aggressive practices (e.g., using harassment, coercion and undue influence to impair consumers' freedom of choice to make purchase decisions). Failure to comply with these duties will constitute a breach of consumer law.

The ASA's primary role is to ensure that ads across UK media stick to the advertising rules written by the Committees of Advertising Practice. Interestingly, the ASA has been making all its rulings and sanctions transparent on its website, which indirectly serves as a reminder to those making an advertisement online to comply with the specified regulation (ASA). Similarly. the CMA has been working alongside the ASA by producing guidelines for those involved in creating content and postings on social media. For instance, the CMA published two successive sets of guidelines targeted at influencers: the Advertising Guidelines and Transparency Guidelines. The former requires brands and influencers to disclose their commercial relationship in particular postings. The latter focuses on transparency with social media followers and provides further guidance on how influencers who received incentives should disclose their posts.

Analysis

With the proliferation of social media, advertisements can spread in just the blink of an eye. Consequently, it makes regulatory control of advertisements more challenging. There are laws applicable to govern social media advertising in Malaysia. Still, the internet's borderless nature can make the legal frameworks established in the analogue era inadequate to combat the exponential growth of deceptive marketing via social media. There may also be issues with enforcement and monitoring compliance in the social media setting. The integration of social and commercial activities renders consumers more vulnerable, thus making legal intervention more crucial than ever. Legal authorities must 'tool up' to continue meeting their legal obligations. For starters, they need to be more transparent with the public on how they deal with those breaching the advertising law, similar to the approach taken by the UK enforcer. This will raise consumers' awareness while simultaneously serving as a warning to those intending to sell a so-called miracle product on their social media page. When legal enforcement faces challenges in monitoring compliance, it is for consumers to equip

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themselves with knowledge of their statutory rights. At the same time, consumers must join forces with the enforcement authorities by reporting those potentially involved in violating the law for further investigation. Brands and sellers also need to self-regulate themselves to limit legal intervention.

Conclusion

Malaysian social media users are anticipated to increase in the coming years. Businesses also widely use social media to promote their brand and activities, signalling the need for legal attention. Legislative and non-legislative reforms are crucial more than ever because consumers are made more vulnerable by the very structure of digital markets. In this regard, all relevant stakeholders have an important role to play. Law enforcers, in particular, need to 'tool up' to ensure that consumers are continually protected while making sure that any action taken against those breaching the advertising law is publicly visible to educate market players. Consumers should not rely solely on legal enforcers to protect their rights. Consumers need to make themselves aware of the prohibited advertising practices and join forces with legal enforcement by monitoring and reporting advertisement that is against the law. Most importantly, sellers and those making advertisements on the so-called miracle products should be aware of the potential legal consequences before making any post. The punishments are severe compared to the profits gained from that particular post or endorsement.

Legal research on consumer protections against misleading and exaggerated claims on products promoted via social media is still limited in Malaysia. These practices are still prevalent on social media, and the authorities have taken no significant action thus far to combat these activities. Hence, extensive legal research may serve as a wake-up call to the gravity of the issue in question. Regrettably, this paper is unable to delve into the issues in detail. Future research may discuss other legislations, guidelines and related agencies, such as the Communication and Multimedia Act 1998, the Malaysian Code of Advertising Practice and the Advertising Standards Malaysia. Future research can also broaden its scope to include cross-border legislation and social media platforms that serve as the 'gatekeeper' and 'intermediary' for sellers, influencers and relevant parties in advertising products. Lastly, the doctrinal and comparative research herein can be a starting point for empirical research to understand how consumers view the relevant posts and to what extent they are adversely affected by that advertisement. Indirectly, it would provide valuable insights into the necessity for regulatory and non-regulatory intervention.

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DYNAMIC CAPABILITY, TECHNOLOGICAL ABILITY, INNOVATION AMBIDEXTERITY, AND AGILE LEADERSHIP: A HYPOTHESIZED RESILIENCY MODEL FOR PET CARE SERVICE MSME PROPRIETORS OF THE PHILIPPINES

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Abstract: *The COVID-19 pandemic has severely affected businesses particularly micro, small, and medium enterprises. In the Philippines, over 70% of MSMEs have experienced cash flow problems which resulted in layoffs, temporary shutdowns, or worst, permanent closure. This experience served as an eye-opener for entrepreneurs engaged even policymakers to make business pandemic-proof or resilient. One sector that is affected severely is pet care services. During the early months of the pandemic, pet care services temporarily closed in compliance with Philippine government regulations. While some managed to resume their operations gradually, around 70% failed to recover and decided to close their business pet care shops indefinitely. This study aims to propose a hypothesized model that shows the different factors that affect business resiliency using a systematic literature review. The results of this exploratory study will be used as a basis for a quantitative study that will measure the relationship between the variables identified in the literature review.*

Keywords: *Dynamic Capability, Technological Ability, Agile Leadership, Business Resilience, MSME, Pet Care Services*

Introduction

The role of entrepreneurship in social and economic development is of interest to both academics and policymakers. Entrepreneurship is widely regarded as the most important source of economic growth and flexibility, as well as job creation, innovation, wealth creation, and personal development (Mortan et al., 2014). It is also seen as a method for eradicating poverty (Botha & Taljaard, 2021).

However due to globalization and most recently the COVID-19 pandemic, business complexity and competitiveness have become increasingly difficult. MSMEs are the backbone of the economy, yet they are nonetheless exposed to external shocks like financial crises, natural disasters, and forced changes in the business environment, such as the COVID-19 pandemic response.

In the Philippines, Micro, Small, and Medium Enterprises (MSMEs) account for 99.5 percent of all commercial establishments in the Philippines, employing around 63 percent of the country's workforce according to the Philippine Department of Trade and Industry (DTI). The COVID-19 pandemic has had a significant impact on businesses, particularly micro, small, and

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medium-sized businesses. According to a survey done by Shinozaki & Rao (2021) of the Asian Development Bank (ADB), over 70% of MSMEs in the Philippines have faced cash flow issues, resulting in layoffs, temporary shutdowns, or, in the worst-case scenario, permanent closure.

The pet care services industry is one of the most significantly impacted by the COVID-19 pandemic. Pet-care businesses temporarily shut down in accordance with Philippine government rules in the early months of the outbreak. While some pet care businesses were able to gradually restart operations, some business owners were unable to do so. Using a thorough literature analysis, this study seeks to provide a hypothesized model that illustrates the many elements that influence corporate resilience. Quantitative research that measures the association between the factors found in the literature review will be built on the findings of this exploratory investigation.

Literature Review

Dynamic Capability

Dynamic capability refers to an organization's ability to renew itself through time. To acquire a competitive edge, a company's resources must be aligned with the changing business environment through business processes or operational capabilities (Zaefarian et al., 2017). It is considered as one of the primary drivers of a firm's performance in changing settings is dynamic capabilities, which are defined as restructuring a company's resource base to better identify and grasp opportunities (Schilke et al., 2018).

According to Kristinawati and Hidajat (2017), dynamic capability represents a company's ability to attain competitive excellence, implying that dynamic capability is linked to performance. Companies can survive through fast changes in the environment if they have dynamic capabilities that impact the rate of their adjustment processes (Dyduch et al., 2021) as dynamic capabilities incorporate processes that enable businesses to maintain outstanding performance over time (Wilden et al., 2013).

Technological Ability

Technological ability is critical for a company's efficiency in terms of innovation and manufacturing process (Salisu et al., 2020). According to Zawislak (2012), technological ability encompasses not just technical mastery, but also the ability to grow and deploy the firm's fundamental skills, as well as efficiently combine and mobilize technological resources across the organization.

Digitalization and the use of ICTs boost MSME performance, according to numerous studies (Jingtao et al., 2013; Cuevas Vargas et al., 2016), gain competitive edge (Rahmani et al., 2015), stretch the MSME's competitive capabilities (Unsal & Cetindamar, 2015; Kang et al., 2017), and allows for the development of the firm's longevity (Weller, 2020).

Agile Leadership

Agile leadership is characterized by Parker et al. (2015) as sharing responsibilities, being successful in spotting problems and making choices, having an adaptable system, and having a flexible framework. Agile leadership enables for consistency in strategy execution, rapidly articulates, builds a strategy into the business logic and infrastructure choices (Li et al., 2018)

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and in an unexpected situation, must be fast, adaptive, and flexible in responding to unforeseen circumstances (Attar & Abdul-Kareem, 2020).

Innovation Ambidexterity – Exploration Innovation

The word "exploratory innovation" refers to businesses developing new knowledge, products, and services through the continual quest for fresh information (Zhang et al., 2021). It also alludes to long-term potential, increased unpredictability, and room for managerial freedom (Dranev et al., 2020). Exploration helps businesses to test out new ideas and adapt to changing circumstances (Khan et al., 2020).

Innovation Ambidexterity – Exploitation Innovation

Exploitation is the process of refining and increasing performance to create a predictable outcome by extending an organization's existing capabilities, processes, and technology (Zhang et al., 2021). Exploitation according to Duodu and Rowlinson (2020), concentrates on what the company already has and understands.

Business Resilience

In business and management studies, the concept of 'resilience' is new (Anderson et al., 2019; Duchek, 2019). It came to light lately when researchers and academics began to look into how firms expand and create new skills under difficult times (Ma et al., 2018). Small enterprises, it is claimed, face higher unpredictability and resource limits than larger organizations, posing challenges to organizational resilience (Wishart, 2018).

According to Sahebjamnia et al. (2018), a company that demonstrates resilience is capable of carrying with its critical functions with the bare minimum of business continuity goals and enduring the longest duration of interruption possible. In order to survive and thrive, MSMEs must create adequate strategic crisis planning (Muñoz et al., 2018) and access to money, material assets, networking, and strategic and operational flexibility have all been proven to be critical for small business resilience, particularly in times of crisis (Pal et al., 2014).

Hypothesized Model

Based on the synthesized literature, the figure below presents the hypothesized model which shows the relationship among the variables. The hypothesized relationships of the independent variables which are dynamic capability, technological ability, and agile leadership to a dependent variable which is business resilience. Moreover, exploration and exploitation innovation also referred to as innovation ambidexterity is posited to have mediating roles between the independent and independent variables.

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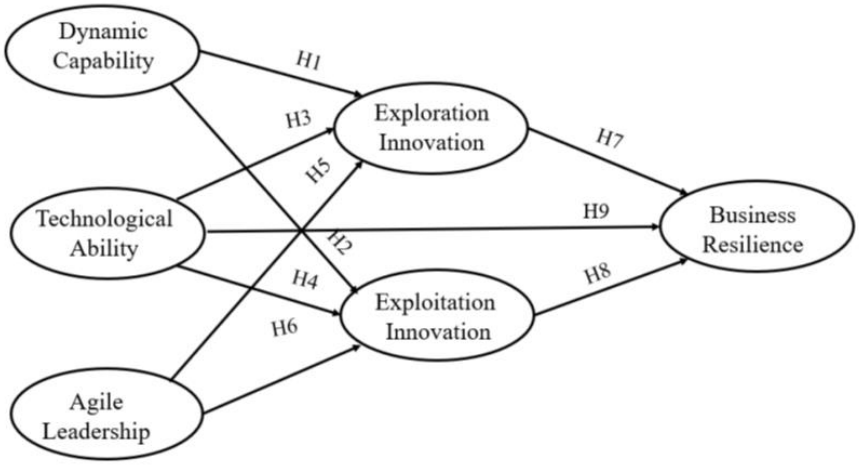

Figure 1: The Proposed Model

Research Method

This research reviews existing studies that validated the different factors that have an impact on business resiliency. The reviewed journals were synthesized, summarized, and presented in this paper. Based on the synthesis, the following were identified as the independent variables as shown in the hypothesized model: dynamic capability, technological ability, and agile leadership. On the other hand, innovation ambidexterity which is divided into exploration innovation and exploitation innovation will serve as the mediating variables.

Conclusion

The COVID-19 pandemic caught everyone by surprise and exposed many gaps including the resiliency of many businesses, particularly the micro, small, and medium enterprises (MSMEs). The synthesized literature provided insights into the different factors that impact business resilience. These factors were used to propose a resiliency model that will become a basis for quantitative research. These factors are dynamic capability represents a company's ability to attain competitive excellence, and technological ability, which is about integrating digitalization, agile leadership which focuses on flexibility, innovativeness, and adaptability. Moreover, innovation ambidexterity deals with exploring new possibilities and using existing resources to become resilient.

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SOLUTE DISPERSION IN AN UNSTEADY HERSCHEL-BULKLEY FLOW THROUGH AN INCLINED STENOSED ARTERY

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Abstract: *Motivated by the concept of blood flow in a stenosed artery, this present research investigates the influence of stenosis shape in terms of height and arterial inclination on the blood flow and solute dispersion behaviour through an inclined stenosed artery. The blood rheology is depicted using the Herschel-Bulkley model in a laminar, axisymmetric and incompressible unsteady flow through the stenosed artery. The effect of stenosis is focused on the stenosis height for both sine and cosine stenosis. Parameters of arterial inclination are also investigated to observe the effect of inclination on the blood velocity and dispersion function. Perturbation method is adopted in solving for the blood flow velocity under the effect of stenosis height and arterial inclination. The dispersion function of solute dispersion is solved using the obtained blood velocity by adopting the Generalized Dispersion Model (GDM) in obtaining steady dispersion functions. This present study shows that the increase in stenosis height decreases both blood velocity and dispersion function. Meanwhile, the increase in arterial inclination increases the blood velocity and dispersion function. The effect of stenosis height also affects blood velocity and dispersion function for the sine stenosis more than the cosine stenosis.*

Keywords: *Unsteady Blood Flow, Unsteady Solute Dispersion, Herschel-Bulkley Model, Perturbation Method, Generalized Dispersion Model.*

Introduction

The research of hemodynamics in stenosed artery is a significant contribution to the biomedical field related to the application in treatment of atherosclerosis, angina, heart attacks and many more. The presence of stenosis at the arterial could cause the narrowing of the artery and total blockage if left untreated. Treatments of stenosed artery include oral medication, drug injection and angiogram which considers the aspect of solute dispersion in determining the success of those treatments. For instance, the effectiveness of drug injection to treat the stenosed artery is influenced by the blood flow and solute dispersion behaviour within the artery. Therefore, it is important to consider the stenosis size and arterial inclination to decide the appropriate artery location and drug dosage to ensure optimal treatment with minimised complication.

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In depicting the blood rheology for theoretical study, Newtonian and many other non-Newtonian models have been used by researchers depending on the boundary layer problem studied. This present study focuses on a very narrow artery problem due to the presence of stenosis at the arterial wall. Certain models could not describe the blood flow in a very narrow artery where the yield stress is high and shear rate is low. However, the Herschel-Bulkley model containing an additional parameter of power-law index can explain the different blood physiological behaviours (Rajashekhar et al., 2018). Chaturani et al. (1985) stated that blood behaves like Herschel–Bulkley model rather than Power Law and Bingham models for a tube with 0.095 mm diameter. Iida (1978) adopted the Hershel-Bulkley and Casson model in their study of blood flow in arterioles with diameters less than 0.065 mm and concluded that the velocity profiles can be explained using the Herschel-Bulkley model; yet does not obey the Casson model. Additionally, the Herschel-Bulkley model can also be reduced to other models such as Newtonian, Power Law and Bingham models by assigning a certain value to the power-law index parameter. It is clear that Herschel-Bulkley model have advantages compared to other models in terms of its capability to explain blood flow in a very narrow artery and be reduced to other models.

There are numerous studies that investigates the unsteady blood flow through a stenosed artery using the Herschel-Bulkley model. Not to mention, the aspect of arterial inclination should be considered as many ducts in a physiological system have some inclination rather than being horizontal (Prasad & Radhakrishnamacharya, 2008). Priyadharshini and Ponalagusamy (2018) studied the blood flow through an inclined, tapered stenosed artery with the presence of body acceleration using the Herschel-Bulkley nanofluid model. They stated that the resistance experienced by blood flow increases as the stenosis height increases. However, increase in the inclination parameter decreases the flow resistance. Abbas et al. (2017) adopted the Herschel-Bulkley model in their study of unsteady blood flow through an overlapping stenosed artery and concluded that the plug core radius decreases as the stenosis size increases. Few other studies that utilized the Herschel-Bulkley model in their boundary layer problems of stenosed artery can also be seen in these researches [(Srivastava, 2018), (Zaman et al., 2016) and (Shabbir et al., 2018)]. However, most of the studies largely focuses on investigating the effect of stenosis or inclination on the blood flow behaviour while neglecting the aspect of solute dispersion such as the dispersion function solution. An extensive study on solute dispersion inside an inclined stenosed artery helps doctors and pharmacists in deciding the dose and distribution rate of medication to patients with less risk of causing toxicity.

In previous studies, the Herschel-Bulkley model is widely used in depicting blood rheology for solving problems related to solute dispersion in blood flow, mainly in a very narrow artery. However, the study on solute dispersion of dispersion function in an unsteady blood flow using Herschel-Bulkley model in an inclined stenosed artery has not yet been explored. Therefore, this present study focuses on the effect of stenosis height and artery inclination on the behaviour of blood flow and solute dispersion using the perturbation and generalized dispersion model (GDM) methods to extend the study of previous researches.

Mathematical Formulation

Consider the unsteady, axisymmetric, laminar and fully-developed unidirectional blood flow represented by the Herschel-Bulkley model through an inclined artery with the presence of stenosis at the arterial wall as shown in Figure 1 where $\bar{w}(\bar{z},\bar{t})$ is the blood velocity in axial

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direction, $\bar{r}$ is the artery radius, $\bar{t}$ is time, $\bar{g}$ is the gravitational acceleration and θ is the degree of the arterial inclination. Therefore, the gravitational acceleration in the $\bar{z}$ direction is given as $\bar{g}\sin\theta$. The blood flow region within the artery is separated into the plug flow region of $0 \le \bar{r} \le \bar{r}_c$ and outer flow region of $\bar{r}_c < \bar{r} \le \bar{R}$ where $\bar{r}_c$ is the plug flow radius and $\bar{R}$ is the full artery radius which can be replaced by the formula of cosine or sine stenosis. The presence of stenosis at the arterial wall is indicated by $\bar{R}(\bar{z})$ where $\bar{\delta}$ is the stenosis height and $\bar{l}_0$ is the stenosis length. Cylindrical polar coordinates are used in the formulation and computation of this present study.

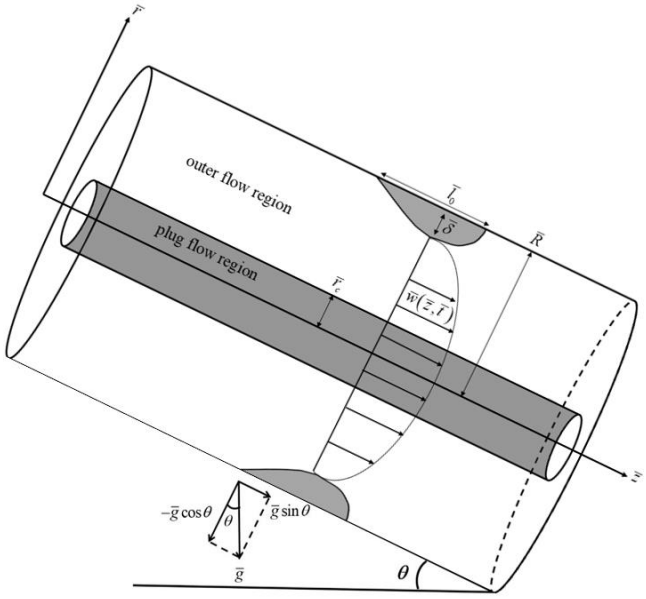

Figure 1: Geometric Depiction of Blood Flow in An Inclined Stenosed Artery.

Since the blood flow is a unidirectional flow in the $\bar{z}$ direction, the governing equations of continuity and momentum in cylindrical coordinate are reduced into the following form of

$$\frac{\partial\bar{\rho}}{\partial\bar{t}} + \frac{\partial(\bar{\rho}\bar{w})}{\partial\bar{z}} = 0, \tag{19}$$

$$\bar{\rho}\frac{\partial\bar{w}}{\partial\bar{t}} = -\frac{d\bar{p}}{d\bar{z}} - \frac{1}{r}\frac{\partial}{\partial\bar{r}}(\bar{r}\bar{\tau}) + \bar{\rho}\bar{g}\sin\theta \quad \text{for} \quad 0 \le \bar{r} \le \bar{R}(\bar{z}), \tag{20}$$

where $\bar{\rho}$ is the fluid density, $\bar{p}$ is the pressure and $\bar{\tau}$ is the yield stress. The stenosed artery radius $\bar{R}(\bar{z})$ for cosine stenosis is defined as

$$\bar{R}(\bar{z}) = \begin{cases} \bar{R} & \text{otherwise,} \\ \bar{R} - \dfrac{\bar{\delta}}{2}\left[1 + \cos\left(\dfrac{2\pi}{\bar{l}_0}\left(\bar{z} - \bar{d} - \dfrac{\bar{l}_0}{2}\right)\right)\right] & \text{when} \quad \bar{d} \le \bar{z} \le \bar{l}_0 + \bar{d}, \end{cases} \tag{21}$$

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and for sine stenosis is defined as

$$\bar{R}(\bar{z}) = \begin{cases} \bar{R} & \text{otherwise,} \\ \bar{R} - \bar{\delta}\sin\left[\dfrac{\pi(\bar{z}-\bar{d})}{\bar{l}_0}\right] & \text{when } \bar{d} \le \bar{z} \le \bar{l}_0 + \bar{d}. \end{cases} \tag{22}$$

where $\bar{d}$ is the stenosis location. The momentum equation in Equation (2) has the boundary condition of

$$\bar{\tau} \text{ is finite at } \bar{r} = 0. \tag{23}$$

The constitutive equation of the Herschel-Bulkley model is defined as

$$\bar{\mu}_H\left(\frac{\partial \bar{w}}{\partial \bar{r}}\right) = -\left(|\bar{\tau}| - \bar{\tau}_y\right)^n \quad \text{if} \quad |\bar{\tau}| \ge \bar{\tau}_y, \tag{24}$$

where $\bar{\tau}_y$ is the yield stress, $\bar{\mu}_H$ is the Herschel-Bulkley viscosity, and n is the power-law index. The boundary conditions of Equation (24) are

$$\begin{aligned} &\bar{w} = 0 \ \text{ at } \ \bar{r} = 0, \\ &\bar{w} = 0 \ \text{ at } \ \bar{r} = \bar{R}(\bar{z}). \end{aligned} \tag{25}$$

The governed unsteady convective-diffusion equation for the dispersion of solute is given as

$$\frac{\partial \bar{C}}{\partial \bar{t}} + \bar{w}\frac{\partial \bar{C}}{\partial \bar{z}} = \bar{D}_m\left(\frac{1}{\bar{r}}\frac{\partial}{\partial \bar{r}}\left(\bar{r}\frac{\partial}{\partial \bar{r}}\right) + \frac{\partial^2}{\partial \bar{z}^2}\right)\bar{C}_m, \tag{26}$$

where $\bar{C}$ is the solute concentration and $\bar{D}_m$ is the molecular diffusivity. Equation (26) has the initial and boundary conditions of

$$\begin{aligned} &\bar{C}(\bar{r},\bar{z},0) = \bar{C}_0 \quad \text{if} \quad |\bar{z}| \le \bar{z}_s/2, \\ &\bar{C}(\bar{r},\bar{z},0) = 0 \quad \text{if} \quad |\bar{z}| > \bar{z}_s/2, \end{aligned} \tag{27}$$

$$\bar{C}(\bar{r},\infty,\bar{t}) = 0, \tag{28}$$

$$\frac{\partial \bar{C}}{\partial \bar{r}}(0,\bar{z},\bar{t}) = \frac{\partial \bar{C}}{\partial \bar{r}}\left(\bar{R}(\bar{z}),\bar{z},\bar{t}\right) = 0, \tag{29}$$

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where $\overline{C}_0$ is the reference solute concentration and $\bar{z}_s$ is the solute length.

Method of Solution

Consider the non-dimensional variables as below:

$$r=\frac{\bar{r}}{\bar{R}},\quad w_c=\frac{\bar{w}_c}{\bar{U}},\quad w_o=\frac{\bar{w}_o}{\bar{U}},\quad t=\frac{\bar{t}\bar{w}_m}{\bar{R}},\quad p=\frac{\bar{p}\bar{R}}{\bar{\mu}\bar{U}},\quad \tau_y=\frac{\bar{\tau}_y\bar{R}}{\bar{\mu}\bar{U}},\quad z=\frac{\bar{z}}{\bar{R}},$$
$$\rho=\frac{\bar{\rho}\bar{R}\bar{U}}{\bar{\mu}},\quad g=\frac{\bar{g}\bar{R}}{\bar{U}^2},\quad \alpha=\frac{\bar{R}\bar{w}_m\bar{\rho}}{\bar{\mu}},\quad C=\frac{\bar{C}}{\bar{C}_o},\quad D_m=\frac{\bar{D}_m}{\bar{U}\bar{R}},\quad R(z)=\frac{\bar{R}(\bar{z})}{\bar{R}}, \tag{30}$$

where $\bar{\mu}=\bar{\mu}_H\left(\bar{R}/\bar{U}\bar{\mu}\right)^{n-1}$ is in the dimension of the viscosity of Newtonian fluid. Substituting the non-dimensional variable into the momentum equation in Equation (20) and constitutive equation in Equation (24), the non-dimensionalized momentum and constitutive equations are respectively obtained as

$$\alpha\frac{\partial w}{\partial t}=-\frac{dp}{dz}-\frac{1}{r}\frac{\partial}{\partial r}(r\tau)+\rho g\sin\theta, \tag{31}$$

where α is the Reynolds number defined by $\alpha=\bar{R}\bar{w}_m\bar{\rho}/\bar{\mu}$ and

$$\tau=\left(-\frac{\partial w}{\partial r}\right)^{1/m}+\tau_y. \tag{32}$$

The series expansion of the perturbation method is obtained using the Reynolds number α as the small parameter (where $\alpha<<1$). Velocity w and shear stress τ are expanded in perturbation series as follows:

$$w(r,z,t)=w_0(r,z,t)+\alpha w_1(r,z,t)+..... \tag{33}$$

$$\tau(r,z,t)=\tau_0(r,z,t)+\alpha\tau_1(r,z,t)+..... \ . \tag{34}$$

Substituting w in equation (33) and τ in equation (34) into equation (31) and (32) respectively and equating the coefficient of constant and α term in the left-hand side (LHS) to the right-hand side (RHS), the equations obtained are

$$\frac{\partial}{\partial r}r\tau_0=r\left(-\frac{dp}{dz}+\rho g\sin\theta\right) \tag{35}$$

$$\frac{\partial w_0}{\partial t}=-\frac{1}{r}\frac{\partial}{\partial r}r\tau_1 \tag{36}$$

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$$\frac{\partial w_0}{\partial r} = -\left(\tau_0{}^m - m\tau_0{}^{m-1}\tau_y\right) \tag{37}$$

$$\frac{\partial w_1}{\partial r} = -\left(m\tau_0{}^{m-1}\tau_1 - m(m-1)\tau_0{}^{m-2}\tau_1\tau_y\right) \tag{38}$$

where $r_c = -2\tau_y \big/ \left((dp/dz) - \rho g \sin\theta\right)$. The non-dimensionalized boundary conditions are

$$\tau_0 \text{ and } \tau_1 \text{ are finite at } r = 0 \tag{39}$$

for equation (35) and (36) and

$$w_0 \text{ and } w_1 = 0 \text{ at } r = R(z) \tag{40}$$

for equation (37) and (38). Solving Equations (35) and (36) subject to boundary conditions in Equation (39) and Equations (37) and (38) subject to boundary condition in Equation (40), the solutions for velocity at the outer flow and plug flow region are obtained respectively as

$$w_0 = -\left(-\frac{1}{2}\left(\frac{dp}{dz} - \rho g \sin\theta\right)\right)^m \left[\frac{r^{m+1}-1}{m+1} - r_c\left(r^m - 1\right)\right]. \tag{41}$$

$$\begin{aligned} w_1 = \frac{1}{t}\left(-\frac{1}{2}\left(\frac{dp}{dz} - \rho g \sin\theta\right)\right)^{2m-1} \Bigg[& -\frac{m(m+2)}{2(m+1)^2(m+3)} + \frac{m}{2(m+1)^2} r^{m+1} \\ & - \frac{m}{(m+1)(m+3)(2m+2)} r^{2m+2} + \frac{(2m+3)\left(2m^3+5m^2-m-2\right)}{2(m+1)(m+2)(m+3)(2m+1)} r_c \\ & - \frac{(m-1)}{2(m+1)} r_c r^m - \frac{m}{2(m+1)} r_c r^{m+1} + \frac{m\left(2m^2+5m+1\right)}{(m+1)(m+2)(m+3)(2m+1)} r_c r^{2m+1} \\ & - \frac{(m-1)(m+1)}{2(m+2)} r_c{}^2 + \frac{(m-1)}{2} r_c{}^2 r^m - \frac{(m-1)}{2(m+2)} r_c{}^2 r^{2m} \Bigg]. \end{aligned} \tag{42}$$

The expression of velocity in the core flow region can be obtained by evaluating $r = r_c$ in the w_o to obtain w_c. The velocities obtained are then utilized to solve for the dispersion function by adopting the GDM method. According to the GDM method, the steady dispersion function f_{1s} can be solved from Equation (26) in the form of

$$\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial f_{1s}}{\partial r}\right) = (w - w_m), \tag{43}$$

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where w_m is the mean velocity obtained using the formula

$$w_m = \frac{\int_0^{2\pi}\int_0^{R(z)} wr\, drd\psi}{\int_0^{2\pi}\int_0^{R(z)} r\, drd\psi}. \quad (44)$$

The boundary condition for Equation (43) is

$$\frac{\partial f_{1s}}{\partial r}\left(r=0\right)=\frac{\partial f_{1s}}{\partial r}\left(r=R\left(z\right)\right)=0, \quad \text{for} \quad j=1,2,3,... \quad (45)$$

Equation (43) is solved using integration with respect to *r* subject to the boundary conditions in Equation (45) to obtained the solution of the steady function f_{1s}.

Results and Discussion

The main objective of this study is to analyse the effects of the stenosis height and arterial inclination on the blood velocity and dispersion function of the Herschel-Bulkley flow through an inclined stenosed artery. Hence, other parameters such as the power-law index, pressure gradient, gravitational acceleration and plug core radius are given a constant value of $n=0.95$, $p_s=1$, $g=10$ and $r_c=0.04$ respectively throughout the data plotting for the purpose of discussion on the effects of stenosis height and arterial inclination. As for the stenosis height, the other variables affecting the stenosis size are given constant values of $l_0=3$, $d=2$ and $z=4$. Meanwhile, the stenosis height is mainly analysed at $\delta=0, 0.1, 0.2, 0.3$. The plotted results exhibited by all these variations of parameters were analysed at an angle of inclination in the range of $0°\le\theta\le 90°$ where the numerical value is arbitrary as long as it shows an increase in arterial inclination for the purpose of observation.

The influence of stenosis height and and arterial inclination on the blood flow velocity are investigated in Figure 2 (a) to (b). Figure 2 (a) shows the blood velocity at arterial inclination $\theta=0°$ and stenosis height $\delta=0,0.1,0.2,0.3$ for both cosine and sine stenosis (dashed line). The graph shows a decrease in blood velocity as the stenosis height increases. However, it can be observed that the decrease in velocity affects the sine stenosis more as the stenosis height increases. Increase in stenosis height reduces the flow region within the artery. Hence, the blood has less space to flow efficiently. The fatty substance deposited at the arterial wall increases the resistance flow; hence the decrease in blood velocity. Not to mention, decrease in the flow region causes the yield stress to increase which also increases the blood viscosity. Similar trend can be observed when the arterial inclination is increased to $\theta=90°$ in Figure 2 (b). Increase in stenosis height reduces the blood velocity and the blood flow through the sine stenosed artery is affected more by the increase in stenosis height. However, it can also be observed that increasing the arterial inclination from $\theta=0°$ to $\theta=90°$ increases the overall blood velocity. This is due to the blood flow velocity being accelerated by the gravity as the artery inclined towards vertical position. It can be said that inclining the artery helps the blood flow faster if the stenosis slows down the flow.

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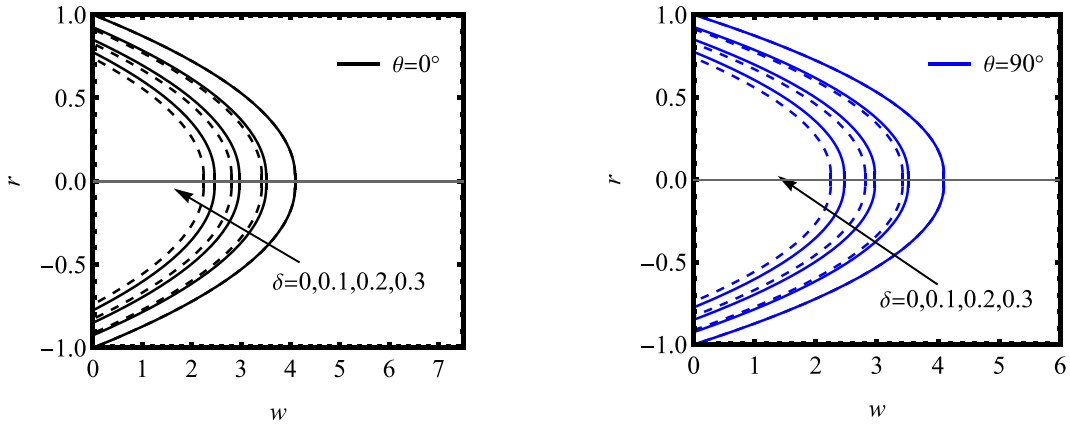

Figure 2 Variation of non-dimensionalized velocity of unsteady Herschel-Bulkley fluid with fixed values of $m=1.05$, $g=10$, $t=1$, $r_c=0.04$ for $\delta=0,0.1,0.2,0.3$ at (a) $\theta=0°$ and (b) $\theta=90°$.

The impact of stenosis height and and arterial inclination on the blood flow velocity are investigated in Figure 3 (a) to (b). The blood velocity at arterial inclination $\theta=0°$ and stenosis height $\delta=0.1,0.3$ for both cosine and sine stenosis for increasing time parameter of $t=0.1,0.5,1$ is shown in Figure 3 (a). Observation shows that he blood velocity increases as the time increases. It can be noted that the increase in velocity is high at the stating point and slows down as the time increases. After a certain amount of time, the blood flow reaches a steady state velocity flow. However, the increase in stenosis height reduces the increase in velocity as the time increases. Graphical plotting showns that the the increase in stenosis height for sine stenosis amplify the reduction of the blood velocity. Therefore, it can be said that the sine stenosis affects the changes in blood velocity more compared to the cosine stenosis. Similar pattern behaviour is observed when the artery is inclined to $\theta=90°$ as shown in Figure 3 (b). Increase in time parameter increases the blood velocity for both sine and cosine stenosed artery. Nevertheless, graphical plotting shows that increasing the arterial inclination from $\theta=0°$ to $\theta=90°$ increases the overall blood velocity. The gravitational acceleration helps amplify the blood flow as the artery inclined towards vertical position. From this theoretical result, inclining the artery can help counter the reduction of blood velocity due to the presence of stenosis; for a situation where a high blood velocity is preferred.

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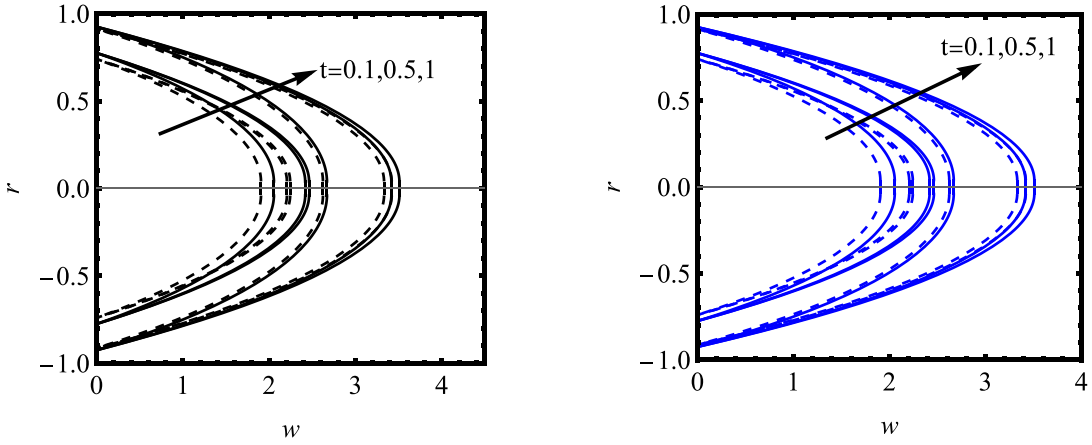

Figure 3 Variation of non-dimensionalized velocity of unsteady Herschel-Bulkley fluid with fixed values of $m = 1.05$, $g = 10$, $r_c = 0.04$ at $\delta = 0.1, 0.3$ for $t = 0.1, 0.5, 1$ when (a) $\theta = 0°$ and (b) $\theta = 90°$.

The effect of stenosis height and and arterial inclination on the dispersion function are investigated in Figure 4 (a) to (b). Figure 4 (a) illustrates the dispersion function of solute dispersion at arterial inclination $\theta = 45°$ and stenosis height $\delta = 0, 0.1, 0.2, 0.3$ for both cosine and sine stenosis (dashed line). It can be seen that the dispersion function decreases as the stenosis height increases. This is due to the solutes having less space to disperse smoothly. The blood cells and all the other materials suspended in the blood fluid are cramped and having difficulties in diffusing efficiently. Nevertheless, the decrease in dispersion function due to the increase in stenosis height affects the sine stenosis more compared to the cosine stenosis. Additionally, flow region decrease causes increase in yield stress which in turn increases the blood viscosity. Similar trend can be observed when the arterial inclination is increased to $\theta = 90°$ in Figure 4 (b). As the stenosis height increases, the dispersion function decreases and the dispersion through the sine stenosed artery is affected more by the increase in stenosis height. Nevertheless, the increase of arterial inclination from $\theta = 45°$ to $\theta = 90°$ increases the overall dispersion function. The gravitational acceleration helps the dispersion of solute along the artery as the artery inclines toward vertical position.

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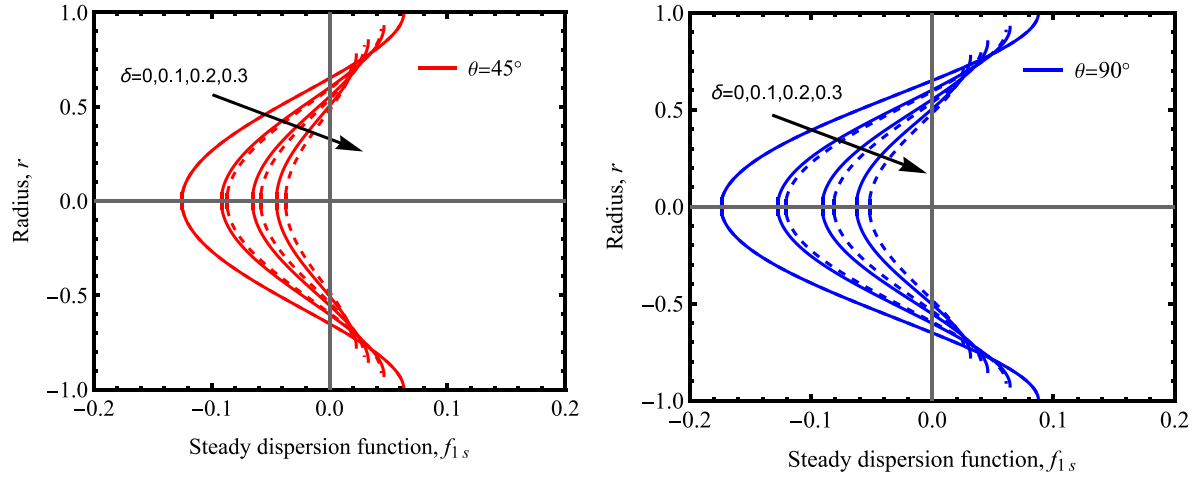

Figure 4 Variation of steady dispersion function with fixed values of $m=1.05$, $g=10$, $r_c=0.04$ for $\delta=0,0.1,0.2,0.3$ at (a) $\theta=45°$ and (b) $\theta=90°$.

Results and Discussion

This present research investigates the influence of stenosis height and arterial inclination on the blood velocity and dispersion function through an inclined stenosed artery. The effects are observed on both artery with sine and cosine stenosis and a comparison is made. This present study concluded that

1) Increase in stenosis height decreases the blood velocity and dispersion function.
2) Increase in arterial inclination decreases the blood flow and dispersion function.
3) The blood velocity increases and reaches a steady state as the time increases for both cosine and sine stenosed artery.
4) The decrease in blood velocity and dispersion function due to increase in stenosis height and arterial inclination affects the artery with sine stenosis more compared to the cosine stenosis.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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