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EDITORIAL

It is my proud privilege to welcome you all to the World Research Society International Conference at Soweto, South Africa. I am happy to see the papers from all part of the world and some of the best paper published in this proceedings. This proceeding brings out the various Research papers from diverse areas of Science, Engineering, Technology and Management. This platform is intended to provide a platform for researchers, educators and professionals to present their discoveries and innovative practice and to explore future trends and applications in the field Science and Engineering. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Thus the forum accelerates the trend of development of technology for next generation. Our goal is to make the Conference proceedings useful and interesting to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve the goal.

I once again give thanks to the Institute of Research and Journals & World Research Society for organizing this event in Soweto, South Africa. I am sure the contributions by the authors shall add value to the research community. I also thank all the International Advisory members and Reviewers for making this event a Successful one.

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Dr. P. Suresh M.E, Ph.D. Professor and Controller of Examinations, Karpagam College of Engineering., Coimbatore, India.

RETINAL IMAGE SYNTHESIS FOR DIABETIC RETINOPATHY ASSESSMENT USING DCGAN AND VAE MODELS

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Abstract - Amongst the most significant considerations in classification of the image is the data amounts particularly in the medical images. Although the main challenge in the healthcare sector is 'attaining the datasets. In this, we display the images of the synthesized retinal fundus by preparing a VAE i.e., Variational Autoencoder & another model known as the DCGAN, adversative model on almost 3662 images of retina which have been captured from a dataset known as the APTOS- Blindness dataset. The finding of this method is in creating the images of retina without the usage of vessel segmentation that is previously used. This enables the system to become independent. The models which are acquired are the synthesizers of the image that are proficient in producing resized images of retina of any amount from a basic regular distribution. Moreover, a lot of images than this have been utilized for the purpose of training than any other task in literature. The assessment or appraisal of a synthetic image is done by giving an output to a CNN model & the average squared error was counted between the average 2-Dimensional hologram of images that were real and synthetic as well. Later, by analyzing the latent space and average loss of the images. The achieved outcomes out of the analysis inferred that the general images have less extent of loss in DCGAN as opposed to Variational Auto Encoders.

Keywords - Diabetic Retinopathy, Data Augmentation, Generative Adversarial Network, DCGAN, Variational Auto Encoder.

I. INTRODUCTION

Diabetic retinopathy (DR) is a very common disease-is responsible for the loss of vision among diabetic people. ophthalmologists or eye specialists usually detect, & check DR severity based on number of similar lesions and types. In accordance with the international convention, the intensity of Diabetic Retinopathy can be classified in 5 levels: normal, mild, moderate, severe non-proliferative DR (NPDR) and PDR. The lesions comprise of exudates, soft exudates, haemorrhages, microaneurysms, laser marks, proliferate membranes, etc. It is very laborious & uneasy for even for the eye specialists to detect DR, so automated DR grading models have started to be considered over the past few years. Numerous past works, choose deep models to carry out DR grading and acquire significant advancement over other techniques. Training an efficient deep CNN model generally needs a huge amount of varied and balanced data. Despite that, the data distribution of DR over various grades are immensely disbalanced as aberrant images of fundus only make up a little portion. For instance, in the biggest public DR dataset, EyePACS, images of the levels of DR 3 and 4 are 2.35% and 2.16% of the whole, individually, while regular images of level 0 are 73.67%. Accepting such disbalanced data will make the model less responsive to various samples with greater severity levels of the DR and will result in overfitting. No wonder that basic techniques of data augmentation [11] like flipping & random cropping & rotation can alleviate the issue, the poor variety of the samples from those levels are still responsible for restricting the performance of model. Therefore, in this research paper, we suggest an image generation DCGAN model which creates more

multifarious images of DR with various grading levels and utilize these generated images to aid in the training of a grading model.

A. (GANs) known as Generative Adverbial Networks.

In this deep learning process 2 neural networks are utilized. The first is the generator network and the second is discriminator network. Each one of them is a deep neural network. Basically, in the Generator network, an arbitrary noise is taken as an input to create data that are considered as samples as practicable as possible to an original dataset & also a discriminator network that differentiates between the actual or original data and the generated data as depicted in figure 1.



Fig 1: Architecture of GAN

GANs [9] are basically structures that are prepared to develop realistic designs or actual objects that are hard to discern from the existing real and actual objects i.e. GANs take the training data distribution and create examples that are new from the very same distribution. The GANs are multipurpose models that comprises of 2 different neural network models: a generator and a discriminator. The main objective of the generator network is to create reasonable fake examples. On the contrary, the objective of the discriminator network is to make a distinction between the real example created by the training data & the fake one which is produced from the generator network. Instinctively, a person can see a 'generator network' as forger which falsifies examples to make it look as actual or realistic as possible & the discriminator network as an examiner which tries to distinguish the real and the fake one. During the training, the generator network gets ameliorated at creating artificial examples. In the similar manner, the discriminator network prepared to become an improved investigator or examiner which appropriately distinguishes between the real and the fake samples i.e., it acquires to model the likeliness of an example and identifies it as fake or real. The likeliness or the chances of the model of being real or forged from the discriminator is the one that aids the generator network to create improved samples over the course of time. The balance of the game is where the production of realistic samples that are fake by the help of generator which look identical to the actual samples acquired from the training data. At the same time, the discriminator is left speculating at a fifty percent of the likeliness or the probability that discerns whether the example is fake or real.

II. RELATED WORK

The method or procedure of a deep convolutional denoising autoencoder is founded on the complete changing multi-norm loss function. the minimization feature along with the batch normalization methods have been presented to restore the fundus. It is applied for the restoration of the fundus and to low down the level of noise. On the top of that, the network speed is basically fast for the loud images aa opposed to few other models. It is basically done by fine adjustment of the tunes of the network which requires the dropout tools.

A DR produced generative adversarial network (DR-GAN) [1] to create fundus images that have a high definition can be changed with lesion information and arbitrary grading. The conditioning of Retina generator takes place on the lesion and constructional masks. Moreover, as vectors that are adaptive grading which are modelled from the latent grading spaces that can be used to manage the created grading intensity.

The efficacy of the multitask learning which is related to the problems associated with regression. In materials science, the conducted experiments take place on one ionic conductivity dataset and 7 benchmark datasets. The inference of the experiments that have been conducted indicate that an improvement of performance in generalization of differently variable linear regression examples which take place in the multi-task learning.

With the usage of DCGAN [2], development of retinal images take place which no longer require the procedure of vessel segmentation. Thus, the new

procedure makes it totally unreliable. The models or the examples that have been acquired have the potential of synthesizing trimmed retinal images of any amount from a regular normal distribution. Moreover, many images were utilized in the process of training than any other persisting model. Another method in the synthesis of retinal image used as a system trained on the vessel networks & their equivalent images of retinal fundus. To put in another way, a transformation has been learnt between the retinal fundus and the vessel trees. The prominent drawback of their approach is the reliability of an autonomous algorithm to separate the vessels.

On the foundation of Transfer learning on AlexNet & GoogLeNet models, this methodology is being used an image of DR classification model [6] was explained. The usage of this model is for grading the DR level. Moreover, the EyePacs dataset is utilis ed to get a training set which comprises of images that are 35,126 in number & also the test set 53,576. We observe increased percentage by 90 in the achievement of sensitivity and specificity by the suggested DR interpretable classifier & enables it to identify more intense Diabetic Retinopathy cases. This disease seems to be a continuous disease that needs immediate detection as it is significant to stop the growth of this disease.

Likewise, a regular screening is important in the protection of the eyes of the patient. Thus, the generation of proficient & dependable structure of computer assisted diagnosis of DR as CAD system. The diagnosis of DR detected by the identification of unusual structures in the fundus especially Exudates, Haemorrhages, bright and dark lesions, cotton wool spots, Microaneurysms. Therefore, it is essential to do the segmentation of these parts or elements in a very accurate manner to have a better identification, detection, and localization. The significant methods [12] that are used for detecting the major clinical elements of the DR are 'supervised and unsupervised learning techniques. Disease offering automated screening based on the images of retina.

III. PROPOSED VAE AND DCGAN METHODS

A. Variational Auto Encoders:

1.1. It comprises of 2 neural networks: the first is the encoder also known as the approximate inference network which is responsible for mapping a training sample to a latent or a hidden space & the decoder network which plans or maps from the latent space to an artificial sample. In this task, the latent space is centred isotropic multivariate Gaussian & the encoder & decoder which are completely linked or associated neural networks which consist of an individual hidden layer. Moreover, in the phase of learning also called Training phase, the encoder acquires the latent

variables z from the input data & the decoder extracts those sorts of variables to produce a sample. After that, during the phase of generation, VAE pulls samples from the latent space that rush through the decoder to ultimately acquire an artificial sample, also known as the synthetic sample. The framework of VAE can be depicted from the Figure 2(a)



Fig.2. Architecture of Variational Auto Encoder

B. Deep Convolutional Generative Adversarial Networks:

GAN's or GAN are the deep neural net framework which is composed of the two nets. One is known as the generator and the other (the adversary) is known as the discriminator. A grade of CNN also known as the Deep Convolutional Generative Adversarial Networks (DCGAN) that are supported on a particular strategy. The main advancement on the very first GAN is this framework which produces improved or enhanced quality images & more stability during the stage of training. Following the instructions to create the generator & the discriminator as explained in the research paper by Radford et al., we applied & trained them on the retinal images that have been cropped with the usage of the generator cost functions & the original discriminator. On the similar lines, as in the VAE technique, artificial image generation with the usage of DCGAN [10] majorly comprises of the 2 phases: One is the learning phase and another one as the generation phase. In the first phase, the generator basically pulls out the examples from an N-dimension regular distribution that rush through the generator to acquire an artificial sample & the discriminator effort to make a distinction between the images taken from the generator & the training set images. We can also look at the picture of DGCAN framework or architecture in the Figure 4(b)



The framework has a few developments on the current GAN's. One of the changes are the substitution of all the pooling layers along with the strides convolutions in the fractional strides convolutional in the engine, the usage of Batch normalization in each one of the generator & the discriminator, the complete substitution of completely associated or linked hidden layers with the mean pooling in the end, the usage of LeakyReLU stimulation in the engine or the generator for all of the complete layers excluding the output & the usage for output & use of LeakyReLU stimulation pf every layer in the discriminator. No wonder that the research works have successfully been enhanced in the adversarial models, but the major demanding task is basically the model training. To attain the solution of this issue, we have tracked the suggestion advised in [2] to acquire stability while training tge DCGAN. Suggestions for example the normalizing the input images between -1 & -1, ADAM optimizer used for the engine or the generator with the utilization of a Gaussian distribution for the mini batches which consists of original images that have been utilized for the training of the models and also the latent space.

IV. RESULTS AND DISCUSSIONS

A. DATASET:

An amount of 3662 images from the APTOS Blindness. The testing images almost 1928 in number and the Train images almost 3662 in number have been utilised for the training of the models utilized in this work. The complete dataset comprises of almost 18590 fundus images which are separated into almost 3662 training, 1928 validation & testing image which are almost 13000 in number by the arrangers of Kaggle competition.

In this task, all of the complete experiments have been conducted, a deep learning library consisting of an open-source NVIDIA Titan Xp GPU & Keras were uitlized.

B. Loss Functions [9]:

As we are aware that in the normal GAN, the model of DCGAN imitates a sort of a competition in which the Generator tries to create original or natural images developed by the generator. Increasing the misclassification error of the discriminator while developing more real like images & attempting to trick the discriminator is one of the major objectives of the DCGAN model. This is also known as a 2-players minimax game and can be explained here-

Ex [log(D(x)] + Ez [log(1 - D(G(z)))]]

Where Ex refers to the expected value over all actual data instances, D(x) which is basically the discriminator's estimate of the possibility that the actual data instance x is real, G(z) also known as the generator's output when an actual noise has been

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given z, D(G(z)) is the discriminator's evaluation of the possibility that a take instance is genuine. The expected value (Ez) over all the arbitrary inputs to a generator.

Thus, the arrangement is basically qualified to minimize $\log (1 - D(G(z)))$ & maximize $\log(D(x))$. Now, basically the training of the VAE & DCGAN architectures on the re-scaled & the pre-processed images of retina from the APTOS Blindness dataset with no usage of any data augmentation. For every image size, testing of a scope of N-dimensional latent spaces from almost 32 To 100 latent variables. Every latent variable. Every latent space was examined to control all the systems that don't remember the training database & meanwhile it produces reasonable images of the retina. To do this, Estimation of intermediate latent representation points is done. To train the model of VAE, we conducted a lot of tests & concluded that greater results have been acquires when we utilized a 512-dimension latent space & also 1008 * 1008 spatial resolution. With a little batch size of 64, and running for almost fifty epochs, we acquired the artificial images as depicted in the Figure 4.



Fig.5: Examples of synthetic images generated by the DCGAN architecture

Even though the texture of the synthetic images acquired from VAE is like the realistic images, they are hazy, high loss and don't consist of the expected properties in a fundus image. With the reference to the DCGAN architecture, we have been able to find that realistic images were obtained when using an image size of 128×128 pixels, a small batch size of 64 and 32 epochs. Examples of them are shown in Fig. 5.

The major merit of using this architecture is basically the sharpness of these synthetic images that those which have been created using the VAE technique. For Confirming the discriminator images and the generator, we can count the loss for both. VAE has suffered more loss as compared to the DCGAN. Therefore, the estimation or the evaluation of the images solely created by the DCGAN was continued. The acquired results are expressed in the Table-1 & the figure as well.

Epoch	Discriminator	Generator
	Loss	Loss
1	3.09	0.58
5	0.80	0.81
10	0.74	0.75
15	0.728	0.726
20	0.72	0.77
25	0.70	0.71
30	0.68	0.77
32	0.68	0.77
	Epoch 1 5 10 15 20 25 30 32	Epoch Discriminator Loss 1 3.09 5 0.80 1 10 0.74 15 0.728 20 0.72 25 0.70 30 0.68 32 0.68

Table. I Discriminator and generator loss of DCGAN at random epochs



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Fig.6. losses of discriminator and generator for random epochs represented in Table I.

C. Observations

Tabulated the Discriminator and Generator losses of random epochs. For the discriminator, true sample label is marked as 1, and generator sample label is marked as 0, nevertheless of the quality of the image sample generated. So, D(x) should near to 1 and D(G(z) should near to 0. In our experiment we save just the images that D(G(z) >=0.76 which is close to 1.

V. CONCLUSIONS

In this paper, the 2 generative suggested models which are founded based on VAE & DCGAN framework have been trained on the retinal images that have been resized using the APTOS Blindness 2019 dataset. On the contrary, based on vessel masks, the previous methods have been utilized for the training of the system, the suggested models shown here need not have the vessel masks to create the images. Moreover, with the usage of DCGAN, credible as well as cropped images of retina with no loss were produced & estimated by the medical experts. Inferences after assessing have evidently shown that this system is an acceptable solution and right approach towards a model which is proficient in creating labelled images of the retina.

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LITERATURE REVIEW ON THE EFFECTIVENESS OF DRAMA THERAPY ON CHILDREN WITH AUTISM SPECTRUM DISORDER

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Abstract - Using theatre to treat children with autism spectrum disorder is a fairly recent concept, hence the lack of prevalent application to actual therapy. To examine and identify limitations of present research, this study analyzes studies related to the effect of exposure to theatre on the social skills of children with autism spectrum disorder. Fifteen studies published between 2010 to now were chosen and categorized by type of study (qualitative, quantitative, mixed). The sample, researchers, methodology as well as result analysis were also considered. All studies supported the positive influence of theatre on the social communication of children with autism, especially students with high-functioning autism. Further studies with longer, more intensive theatre intervention must be conducted to properly understand the details of the influence of theatre on children with autism spectrum disorder and utilize it effectively to enhance their social functioning.

Keywords - Theatre, Drama, Drama Therapy, Autism, Social functioning, Social communication.

I. INTRODUCTION

According to the academic circle and the Center for Disease Control (CDC), the prevalence rate of Autism Spectrum Disorder (ASD) has gradually climbed from 4 in 10,000 people to, recently, 1 in 110 people (Yang &Shin, 2016). This can be seen as the result of the expansion of the diagnostic criteria and the implementation of more objective diagnosis standards in "DSM-IV" and "DSM-V" by the American Psychiatric Association (APA). "DSM-V" provides five diagnostic criteria for ASD.

Theatre has been used to treat the mentally ill for a long time. Its ability to encourage interactions and allow participants to share different emotions has drawn attention as an effective treatment for improving social functioning in children with autism in recent decades (Wheater, 2013). Many studies on the effect of theatre are in progress, but most focus on children with high-functioning autism as the research subjects and the majority are descriptive studies based on the observations of instructors that participated in the study. Most researchers are also experts in the fields of theatre and psychology, leading to a lack of clear results on changes in the participants' pragmatic language ability—using language in actual social situations.

The deficits of social communication become the most significant problem for individuals with ASD, regardless of cognitive or language ability. In most cases these impairments are amplified as children reach adolescence, since as the child grows, they experience more complex social situations and with it increases their recognition of their own lack of sociability (Pomeroy, 2016)

Recently, theatre-based intervention has been emphasized as a way to further generalize the effect of treatment. Some cognitive psychologists have asserted that people can learn to read others' thoughts and intentions in the safe, structured environment of drama (Beadle-Brown, et al., 2017). Through theatre people are able to observe others' performances, which in turn naturally becomes a model that can be imitated naturally. Theatre also provides opportunities to think and empathize from the other's perspective as social communication occurs between people (Pomeroy, 2016). Participants are able to offer their own opinions and cooperate as a part of a pair, a small group, or all of the participants (O'Sullivan, 2015).

This study analyzes domestic and international studies on the effect of theatre-based intervention on the social skills development of children with ASD. The purpose of this study is to examine the diverse methods of utilizing theatre and the detailed results of exactly those methods influence how the improvement of social functioning. This study also aims to encourage and vitalize overall research into theatre and ASD and allow educators or therapists to actively use theatre in intervention for children with ASD.

II. METHODS

2.1. Collecting data and Inclusion criteria

For international studies, Google Scholar and PubMed were searched for peer-reviewed articles and thesis from 2010 to 2021 using the following search terms: "autism children, high-functioning, Asperger, drama therapy, theatre, communication, intervention, social interaction, social skill. Other journals, including the journal of Autism and Developmental Disorders and the ASHA's journal of speech, language, and hearing research were also used for data collection.

For domestic studies, this study searched the domestic academic portal, KISS, RISS, andKCI using the following search terms: communication disorder, autism, and drama therapy. To examine relatively recent trends in the research on drama and the social skills of children with ASD, the publication dates were set from 2010 to now. All studies that examined other developmental disorders other than ASD and used adults or young children not attending school as participants were excluded. (Table 1& 2)

	Inclusion Criteria	Exclusion Criteria
Publication Dates	published 2010- 2020	published before 2010
Research Types	academic journal articles, thesis	non-research papers
Publication Language	English, Korean	other languages
Participants	5 to 17 year-old children with Autism attending schools	children with other developmental disorders and infants or adults with ASD
Used Measures	standardized tests non-standard measures, check- list, interviews andobservations	

Table1: Inclusion and Exclusion Criteria

Databases	Terms related with theatre	Participant parameter terms
English research		Autism
PubMed	Theatre	Developmental
Google	Drama	disorder
Scholar	Creative play	Children
ASHA	Theatrical	School
Korean	play	Social
research	Improvisation	communication
KIC		Social behavior
RISS		

Table 2: List of databases and search term used

III. RESULTS AND DISCUSSION

3.1. Qualitative Studies

The sample consists of students with ASD that attend school. The studies do not provide details about their intellectual capacity, and they did not include peers that function as models for students with ASD or facilitate interaction as a subject of the study with the exception of Kempe & Tissot (2012).

As with the quantitative studies, the researchers were pedagogy experts (Cerbo & Rabi (2019), Wheater (2013)) or dramatherapy experts (Kempe (2012), Bae & Lee (2015)) and some studies were carried out together by psychiatrists and drama therapy experts (Godfery (2013)). Very few studies such as Pomeroy (2016) were carried out by speech language pathologists, who, unlike other researchers, aimed to develop programs for speech therapy sessions. Godfery (2013), Wheater (2013), Kempe (2012), and Bae & Lee (2015) determined whether drama had an effect on children with ASD or examined its advantages when utilized in inclusive education. Cerbo (2019) and Pomeroy (2016) also provided methods to create a play for education or therapy or actual usable theatre activities.

Cerbo et al. (2019) details the process of refining a creative drama model to be utilized for socialization for children with autism spectrum disorder. Six children with the disorder participated in creative drama activities based on the Building Blocks Model. The model was modified according to the measured frequencies of five categories of common behavior deficits of the children: lacking interest in being with others, lacking initiative in joining group activities, not readily exchanging social smiles, not initiating to relate with others, and preferring solitary activities. All sessions included six major components for instructors to reference: session title (session focus), activity (session summary), time allotted (duration), teaching aids (material), directions (procedure), and remember (countermeasures). Participants received 21 of these 30-minute sessions of creative drama activities. Part A of the program recorded general observations of the children's performance, while Part B completed the Observation Checklist on Creative Drama for Socialization Skills Enhancement. Both Part A and B were completed for each child and session. Judgement from expert assessors on criteria such as language, format, activities, and relationship to problem validated the module. It is expected that this type of modular instruction will be helpful for both teachers and participants with autism thanks to its ability to clearly track changes and healing capacity.

Godfery (2013) conducted this research to examine observations made of the children with autism spectrum disorder by their guardians and teachers. Participants received the Roundabout theatre's drama therapy project consisting of 11 weekly sessions. sessions provided an open, receptive These environment for children with autism to freely express themselves and work on communication. Every session was modified according to weekly feedback while the basic framework was maintained. 42 responses from guardians and teachers who observed the children during or after drama therapy sessions were collected. Common observations were given in a total of five large categories: feelings, peers, social skills, structure, and families. All comments responded that the drama therapy provided a safe place of acceptance, helped children interact better with typically developing peers and learn social skills through role-playing, reduced anxiety through predictable schedules, and moreover, was backed by a supportive community through the entire process. Further and repeated research using interviews to receive direct feedback is expected to achieve a more

in-depth understanding of the effect of drama therapy and allow short-term and long-term evaluation.

Kempe & Tissot (2012)'s research is centered on examining the formation of a supportive, inclusive environment for youth with autism with typically developing peers using drama. Two girls with autism and a group of typically developing peers were placed in a school specialized in educating students with learning needs. All participants received 13 100minute sessions over the span of 5 months, which were constantly modified through project leader and teaching assistant discussions. During these sessions students practiced theatrical techniques such as improv, puppets, and others that stimulated various senses, allowing the students to learn through diverse approaches. Students were also required to write both collaborative and individual scripts, which were later used for the making of a short film as the outcome of the project. Records of the two girls' performance showed an immediate improvement in their inclusion within the group and understanding of other people's emotions through the imaginary character, "Lauren", that the participants gradually developed over the course of the sessions. By the production of the short film, both girls were able to improvise reactions in certain social situations. Similar detailed. meticulously structured projects are expected to allow students with autism to achieve a better understanding of the imaginary world and skills to use outside of their educational environment.

3.2. Quantitative Studies

All participants in the sample have ASD, and as seen from Pordanjani (2020), Mpella et al. (2019), Beadle-Brown et al. (2017), Corbett et al. (2017), Corbett et al. (2016), Naniwadekar et al. (2016), Tsao (2014), and Bae & Lee (2011), are 7~16-year-old students attending school.Pordanjani (2020), Corbett et al. (2017), and Tsao (2014) included children with highfunctioning autism, and studies Mpella et al. (2019), Beadle-Brown et al. (2017), Corbett et al. (2017), Corbett et al. (2016) and Tsao (2014) included typically developing peers in the intervention.

Researchers carry a variety of occupations: Pordanjani (2020) and Corbett et al. (2017) are by psychology experts, and Mpella et al. (2019) was carried out by a physical education expert with a focus on activities outside of class. Naniwadekar et al. (2016) was carried out by special instructors working in preschools, Tsao (2014) by child education experts and Bae & Lee (2011) by drama therapy experts. Studies also included collaborative research between two or more fields of study: Beadle-Brown et al. (2017) was the interdisciplinary work of psychology and performing arts, and for Corbett et al. (2017) of specialists from the field of psychology, speech and hearing, special education, and pediatrics.

While studies generally focused on the changes in the participants' social behavior, Pordanjani (2020) also examined non-verbal behavior such as aggression as well as verbal behavior such as conversation. Mpella et al. (2019) observed and analyzed behaviors commonly seen in play (collaboration, obedience, attention, repetition) as well as emotional changes (anger, fear). Beadle-Brown et al. (2017) researched the influence of imaginative role-playing on the changes in children's autistic traits, social dialogue status, and emotion recognition ability. Corbett et al. (2017) used physiological variables such as cortisol levels to analyze the anxiety and stress children with ASD experience and confirm the positive effect of plays. In Corbett et al. (2016), researchers from various areas of expertise examined the effect of drama on social competence through multiple subtests. Naniwadekar et al. (2016) observed not only the changes in the children's conversation skills, but also improvements in basic pre-academic skills. Tsao (2014) recorded the frequencies of starting and continuing to play or conversein social play Lee activities.Bae & (2015)verified the improvements in language ability through three official examinations.

Studies	Purpose	Sample	Method	Measures	Findings
Pordanjani, S.R.(2020)	to determine the effectiveness of drama therapy on the social skills of children with high-functioning autism	40 children with high- functioning autism (7- 12yrs)	participated in 12 90-minute weekly treatment sessions for 2 months	GARS questionnaire Matson social skills questionnaire	Drama therapy enhanced social skills consisting of proper social behavior, non- social behavior, aggression and impulsivity, self- esteem, peer communication)
Mpella, M., Evaggelinou, C., & Koidou, E.(2019)	to examine the effects of a theatrical play program on social skills for young children with ASD	6 children with ASD attending primary school	participated in 16 the theatrical play program has theatrical techniques combined with	WISC-IV CARS Observation with COMPASS	the theatrical play is effective in improving the social skills of children with ASD and their interaction with

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			behavioral		typically
			intervention		developing peers
Beadle-Brown, J., Wilkinson, D., Richardson, L.,	to establish the feasibility of		participated in 10 45-minute	ADOS	the social and imaginative intervention using &pod& is
Shaughnessy, N.,	implementing and evaluating	22 children with ASD (7-	sessions every week which has	VABS Ekman faces task interviews	possible and enjoyable for
M., Leigh, J.A., Whelton, B., & Himmerich, J.(2017)	&Imagining Autism& program	12yrs)	participatory play and improvisation	5-point scalequestionnaires	children with ASD to improve social and communicative skills
Corbett, B., Blain, S., Ioannou, S., & Balser M.(2017)	to examine the impact of the intervention on reducing anxiety and stress	30 youths with ASD (8-14yrs)	participated in SENSE, a weekly program of 10 4-hour sessions	- STAI-C - Cortisol exam - PIP	SENSE program improves social competence and reduce anxiety of youth with ASD
Corbett, B., Key, A.P., Qualls, L., Fecteau, S.,Newsom, C., Coke, C.,& Yoder.P.(2016)	To investigate social ability of children with ASD after SENSE intervention	30 youth with ASD (8-14yrs)	participated in SENSE, a weekly program of 10 4-hour sessions	MFD ERP ABAS PIP	SENSE program developed social cognition, brain and functioning of youth with ASD
Naniwadekar, K., Ravi, A., & M.S., S.(2016)	to explore if drama therapy can improve social-emotional and pre- academic skills of children with ASD	8 children with ASD attending preschool	to participate in 20 sessions using story and acting	ACPC-DD	intervention using drama improves the social , emotional and pre-academic skills
Tsao, Y.L.(2014)to assess the effects of social play activities usingPRT on the social behaviors of children with ASD		1 high functioning child, parents, teacher, 1 non- autistic peer	for a non- autistic child to receive a 15- minute PRT session before each play session and play with a child with ASD	observation on frequency of social behaviors of children with ASD	child with ASD showed a stable increase in social behaviors
Bae, H. S. & Lee, S. H(2011)	to show effects of theatre based group language therapy on the development of language and social abilities	3 students with ASD (7-16yrs)	to participate in 70 minutes weekly sessions for 20 weeks	U-TAP REVT KOSECT	the group therapy using creative drama developed language and social ability of the students

Table 3: Description of Quantitative Studies

3.3. Mixed Studies

Rhoades (2014) was carried out by a speech language pathologist, and is also the only research paper included in this study that recorded both qualitative and quantitative data. Rhoades (2014) aims to study the effects of intensive, daily exposure to theatre on the social skills of children with autism spectrum disorder from the parent and teacher point of view. Eight parents and four theatre instructors of the children with autism spectrum disorder between the ages 8 to 12 participating in the summer camp 'Autism Centered Theatre (ACT)' were recruited via promotion emails. All children participated in all five 3-hour camp sessions every day. Parent and teacher feedback was recorded using questionnaires consisting of short answer questions and nine Likert scale questions on the children's social skills and interview sessions based on the information from the questionnaires and instructor logs. Results showed that the children had grown attached to these activities and were satisfied with their work in terms of positive experience, and a longer, larger program with groups was recommended.

3.4. Discussion

All results from the fifteen papers this study analyzes indicate that exposing children with autism spectrum disorder to some form of drama does have a positive influence on their overall social skills and psyche. This increase was more apparent in older children attending school and those with high-functioning autism or relatively higher language abilities. Their interaction with their instructors as well as with their peers and parents have also increased overall.

The validity of these improvements, however, cannot be guaranteed due to limited samples and undisclosed or imprecise information. Excluding case studies, more than half of the research samples were under 10 people, and no research samples exceeded 40 people in size. For Godfery (2013), the sample size was left entirely undisclosed, and the age range of the sample was also unspecified for more than half of the studies. With the exception of Wheater (2013), the samples were also limited to individuals with high-functioning autism as well. Regarding the methodology, Corbett (2017) lacks detailed descriptions on the exact methods of intervention. Godfery (2013) and Pomeroy (2016) also do not include a clear description of all activities the participants experienced as a part of the research, and Cerbo et al. (2019) only describes the validation process of the activities and omits the actual results from participants altogether.

The results that are clearly explained tend to depend excessively on descriptive statistics. Qualitative and mixed studies use interviews from observers such as parents or instructors to identify a common answer or description through simple comparison. For example, Rhoades (2014) cross-referenced observations from parents and instructors relayed through post-project interviews to identify certain quotes that indicated similar changes in the children's social skills. Even most quantitative studies use subjectively scaled questionnaires and simply compare pre-test, post-test and follow-up scores. Only Beadle-Brown et al. (2017), Corbett et al. (2016), and Corbett et al. (2017) include objective measures, such as cortisol levels, or secondary analysis on descriptive statistics, such as transferring ADOS results to ADOS2 to confirm their statistical significance.

The maintenance of improved social skills is also unclear. The total number of sessions of the programs carried out by researchers did not exceed 21, the duration of individual sessions was all under 2 hours, and the total duration of the program from pre-testing to follow-up did not exceed fifteen months, according to the provided information. Follow-ups on the changes in the participants' previously increased social skills were only carried out by Beadle-Brown et al. (2017), Pordanjani (2020), and Tsao (2014). Regarding that the social skills of participants did showan overall decreasing pattern after completing the programs in the three previously mentioned researches, increasing the duration or the intensity of the program is required to determine whether the positive effect of exposure to theatre on social skills is merely temporary or maintained enough to be developed and used as a proper means of treating children with ASD.

Most importantly, studies do not focus on the influence of theatre on the pragmatic language abilities of participants. Almost allof the researchers aim to discover the change in "social skills"-which includes interaction as a criterion. As previously explained, this data does not suffice due to the lack of objective measures, and some research measures only address the mechanical parts of socialization, such as U-TAP (articulation check) (Bae & Lee, 2011). Those that do attempt to identify changes in social interaction such as Bae & Lee (2015) only record their frequency and disregard elements such as the duration or quality of the conversation. This may be due to the fact that most studies were carried out by psychologists, educational experts, or theatrical experts. Only the program in Naniwadekar (2016) was taught by educators with professional knowledge of the nature of ASD treatment.

IV. CONCLUSION

Limitations of this study include the size of the data pool itself. The concept of applying drama to therapy for children with autism itself is relatively new and unexplored, hence the lack of proper studies to analyze. The lack of attention paid to this field of study also makes designing and teaching a drama therapy curriculum for children with autism spectrum disorder difficult. Despite the clear flaws of the analyzed fifteen studies and the current limitations, exposure to drama shows a promising outcome for children with ASD. Long-term, professional research and extensive projects targeting various groups of children with ASD may provide new methods to assist children with ASD in developing their social skills.

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COMPUTATIONAL PREDICTION OF siRNA AS A POTENTIAL ANTIVIRAL AGENT AGAINST COVID-19

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Abstract -

Severe acute respiratory syndrome coronavirus 2, also known as COVID-19, has become a public safety issue. It had first originated in Wuhan, China, about December 2019, and later spread to approximately 222 countries owing to its extremely infectious nature. Numerous vaccines have previously been licensed by various authorities across the world to develop herd immunity in the population. In line with these efforts, RNA interference (RNAi) technology offers the possibility of stepping up the fight against this virus.

RNA interference (RNAi) is a novel regulatory and efficient silencing strategy in molecular therapy via a sequence-specific RNA degradation mechanism. Several studies revealed the effectiveness of siRNAs inhibiting viral replication.

In this study, computational tools were used to develop specific siRNA molecules against the spike glycoprotein gene, which encode an important protein that facilitating virus entry into the host cell. Through a strict filtering process, four siRNAs molecules were selected with the best possible activity.

Through a strict filtering process, four siRNAs molecules were selected with the best possible activity. These predicted siRNAs should effectively silence the targeted gene. The siRNA-based approach aims to reduce the time and effort required by conventional trials and wet-lab methods that can be prone to errors, and has the potential to serve as a decent basis for future researchers to develop a successful RNAi therapeutic.

Keywords - Severe acute respiratory syndrome, siRNA Design, Gene Silencing, Spike Glycoprotein.

I. INTRODUCTION

Current Coronavirus disease has become a pandemic danger to public safety. The causative agent is COVID-19 or SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) also known as (Li, 2016).

Since the rapid transmission makes it be disastrous for the entire universe, some precautionary approaches have been described by the healthcare authorities. Quarantine of infected individuals, assertive checking and rapid diagnosis of suspected victims, the use of suitable masks, regular hand cleaning helped to control the advancement of this serious disease (Sohrabi, 2020)

Nucleocapsid protein (N), small envelope protein (E), spike surface glycoprotein (S) and matrix protein (M) are the four major structural proteins of coronavirus and all 60 of which are essential to produce a structurally complete virus (Li, 2019).The spike glycoprotein (or simply "spike protein") is the common spike in the surface of the coronavirus, providing the impression of the crown to the electron microscopy, thus the "corona" Latin: king.(Wan, 2020).

Many efforts have been made to develop vaccines and antiviral drugs to put an end to this globalpandemic(Davis, 2020). These efforts are challenged by the frequent mutation of the virus, which has resulted in variants with higher transmission rates(Mahadi,2021). There are also cases of and reports of ineffectiveness of some licensed vaccines against new variants (Chen, 2021) RNA interference (RNAi) is a gene silencing system, first identified in Caenorhabditiselegans and Drosophila melanogaster (Hannon, 2002). RNAi and associated RNA silencing systems are intended to serve as natural protection against entering viruses and the expression of transposable elements (Fire, 1999). The successful use of miRNAs as an antiviral therapy showed promising results, as observed from several studies(Wee-Sung Park.2002), and it should not be overlooked that siRNA has already been used against certain viruses such as hepatitis B virus(Janssen, 2013), (Yokota, 2003). COVID-19 is an RNA virus, and RNA is an attractive target for RNAi (Guangzhou, 2002). As a result, it is likely that RNAi therapies will be able to efficiently inactivate SARS-CoV-2 mRNA in a sequence-specific fashion and so serve as promising antiviral therapies.

A specific spike glycoprotein (S gene) targeting siRNAs was designed. Silencing this gene has a strong possibility for the prevention and treatment of COVID-19 infection. To our knowledge, no attempts were made in this field yet and this is the first study adopted this strategy regarding COVID-19 therapeutic options

II. RESEARCH METHODOLOGY

1. Sequence Retrieval from NCBI:

Surface glycoprotein gene sequence of COVID-19 (accession number: NC_045512) was retrieved from National Center for Biotechnology Information database (NCBI) <u>https://www.ncbi.nlm.nih.gov</u>.

Reference Sequence of Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, complete genome (NC_045512.2)

2. siRNA Designing:

"i-score designer" software was used. This software measures separate siRNA ratings for different algorithms considering the important parameters (Ichihara, 2007).

3. Primary Filtration:

Filter siRNAs based on parameters of different algorithms: SiRNAs are filtered through a scoring system. Almost all basic criteria and parameters of different algorithms are considered in this scoring system (Elbashir,2002)

4. Specificity check:

Blast search was performed against human genome and transcriptome to screen if the selected siRNA bears homology to any human gene, to avoid gene silencing of any human gene (Ui-Tei, 2005)

5. Secondary Structure Prediction:

The secondary structure of siRNAs was predicted including the corresponding free energy use of MaxExpect in the RNA structure web server (Bellaousov,2013)

6. Final Selection

Finally, it is suggested that at least three different siRNAs for each gene should be designed to achieve the desired results in gene silencing.

III. RESULT

1. Sequence Retrieval from NCBI:

Gene sequence S surface glycoprotein of severe acute respiratory syndrome coronavirus 2 were retrieved from NCBI <u>https://www.ncbi.nlm.nih.gov</u> with accession number of NC_045512.

Reference Sequence of Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, complete genome(NC_045512.2)

2. siRNA Designing:

"i-score designer" program predicted list of 3804 pairs of siRNA targeting the chosen gene. The result is available in the appendix.

Subsequently, the 2nd generation of i-score, Biopredsi and DSIR algorithms were taken into consideration for further screening, on the basis of which the essential siRNA selection rules were developed at three screening stages. Only those pairs that met all the specifications of the previous level have passed to the next level.

1st level screening: The best 10 siRNAs with the highest scores of all algorithms have been chosen and moved to next stage of filtration.

3. Specificity check:

To avoid off target effect (similarity with any human gene) of any of the predicted siRNAs a homology search using NCBI BLAST was performed for both sense or antisense strands. Any siRNA with > 40 alignment score was excluded. To ensure farther accuracy in specificity query coverage with other

genes should be less than Less than 78% siRNAs with good parameters where summarized in the following table.

siRNA	Score	homology with how many genes	coverage	E- Value
1915 sense	<30.2	100	78%	6.1
1915 antisense	<30.2	100	71%	12
1613 sense	<30.2	100	78%	6.1
1613 antisense	<32.2	100	76%	3.1
2273 sense	<30.2	100	78%	6.1
2273 antisense	<30.2	100	71%	12
3321 sense	<30.2	100	78%	6.1
3321 antisense	<30.2	100	71%	12

4. Secondary Structure Prediction:

siRNAs having bonds between nucleotides (< 3 in number) of any type (GC, AU, GU), bond between G and C nucleotides (< 2 in number) and types of secondary structure (circular structure plots) (< 2 in number) passed through this level.



Figure2. Secondary structures of best three predicted siRNA

IV. DISCUSSION

COVID-19 has emerged as a rapidly progressive lifethreatening pandemic with a significant economic impact on various countries. Traditional antivirus drugs were useless. There's a tremendous demand for the production of a therapy. In order to decelerate the outbreak and recover the affected individuals, the development of siRNA therapeutic approaches could be a promising alternative to traditional vaccine designing.

The victorious performance of RNA interference (RNAi) in life sciences is focused on its strong capacity to suppress genes in a particular sequence. The first task for effective RNAi strategies is to identify highly effective siRNAs. Decent progress has been made in supplying individual experimentally validated algorithms focused on major parameters to improve the capacity to produce powerful siRNAs. Still, siRNAs developed according to one algorithm have been shown to be highly efficient despite the fact that they are not fulfilling the criteria of another algorithm. The experimental studies showed a similar variation. Therefore, the utilization of multiple algorithms would also improve the probability of execution. In this analysis, the "I-Score" software has been used because it includes distinct generation algorithms that cover all the essential parameters and

characteristics required to achieve an optimal design of active siRNA.

"I-Score" software predicted siRNAs were filtered according to their scores of the overall algorithms as was mentioned in the results part.

After the best scoring siRNAs were selected, both sense and antisense strands were be checked via BLAST with reference sequence database (Refseq-RNA database) as NCBI to reduce the risk of silencing unintended human genes. Initially, all siRNA with > 40 alignment scores were discarded. For farther insurance, any sequence has a coverage < 78% with other genes that are still considered as a risk factor for off-target effects, so it was discarded.

The formation of the secondary structure of siRNA may inhibit the RISC mediated cleavage of the target. So, the prediction of secondary structure and determination of free energy of folding is crucial. So, guide strands of siRNA were subjected to RNA structure web server in order to predict the possible folding structure and corresponding minimum free energy. At 37°C, finally, we selected siRNAs with the free energy of folding that is greater than zero, which suggests the predicted siRNAs are more accessible for efficient binding. Although predicted free energy, we still used other software "MaxExpect" to visualize the structure. Finally, three siRNAs with the best overall parameters were chosen.

V. CONCLUSION AND FUTURE SCOPE

In this study, three prospective siRNA molecules were proposed to be capable to suppress the COVID-19 pathogenicity by targeting the spike protein. Therefore, we recommend that siRNAs should be synthesized in-vitro according to features provided by our results and their inhibitory outcome most be tested in vitro aligned with the COVID-19 genome with the different cell lines and cultures in labs.Then employed to large scale treatment of COVID-19 pandemic.

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A SIMULATION OF COVID-19 TRANSMISSION UNTIL THE STEADY STATE USING GRAPH ALGORITHM

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Abstract - This research computes the average days to reach the steady state of COVID-19 infection by repeated simulation of human interactions using a bi-directed graph. It examines the effect of one infected person on a community comprising groups of people who interacts daily with each other such as school, commuter train, family, etc. Randomization is used to determine group structure and a bi-directed graph models the network of frequently interacting people. Once a person is infected, the incubation period is 3 days, and this person possibly infects other people for the next 6 days. A randomization distribution determines whether each person directly linked to an already infected person will be infected, or not. The effective reproduction number of the actual data is used in the study. Finally, this study examines how many days are required to reach the steady state where a new infected person is not observed any more. The study highlights number of days at the infections peak and how many days are required to reach the steady state. Future research would consider multiple starting points, ages, genders, ethnicities, seasons, and regions. Furthermore, comparison with results of AI machine learning will be examined.

Keywords - COVID-19, Graph Algorithm, Pandemic Simulations, Steady State

I. INTRODUCTION

According to [1], the SARS-CoV2 coronavirus is a coronavirus. Coronaviruses include viruses that cause common colds, Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS) virus that has been occurring since 2012. It is generally transmitted by droplet or contact infection. The risk of spreading the infection is high even if there are no symptoms such as coughing or sneezing in an enclosed space or when talking with many people in proximity. (WHO reports that a five-minute conversation generally generates about 3,000 droplets, which is about the same as one cough. (WHO reports that a five-minute conversation generally produces about 3,000 flying flies, about the same as one cough. In the case of the new coronavirus, there is a possibility of transmitting the virus to other people from two days before the onset of symptoms to seven to ten days after the onset of symptoms. Since viral shedding is higher immediately before and after the onset of the disease, asymptomatic carriers (those who have no symptoms but have tested positive) may be able to transmit the virus.

As of 2021, the disease has not been successfully contained globally, and pandemics sometimes occurred due to outbreaks of modified coronaviruses, even in countries where vaccination is well advanced. It is important to know when peak infection might happen so healthcare facilities may be able to get some planning time to take in more patients with serious infection conditions. There is a strong need to model the infection spreading more accurately which can prepare governments to decide lockdowns and for how long.

II. SIMULATION METHOD AND USAGE OF THE ACTUAL PANDEMIC PARAMETERS IN JAPAN

Typically, statistical methods are used to simulate the transmission of infectious diseases. For macroscopic prediction of infection, the effective reproduction number is often used, which indicates how many people are infected by one infected person on average. For example, an effective reproduction number > 1.0indicates that the infection is in the spreading phase and that usually the number of cases and severely ill patients is increasing, and the government and society take various measures to lower the effective reproduction number below 1.0 to lead to the end the infection. In addition, a multi-agent system (MAS) or a self-organized system is used to solve the human mutual contact or communication caused infection problems that are normally difficult or impossible for an individual agent or a monolithic system.

This paper simulates the infection of high school students. Therefore, each person is represented as a nodeand each node could be given various characteristics. The adjacent-matrix representation of the graph on page 861 in [1] is adopted to express mutual human interactions by bi-directed graph. C++ is used as the coding language, and the "class structure" of each node is set to the extent and depth of each individual's sociability and the infectivity of each individual. The infectivity of each individual increases when they are sociable and talk a lot, or when they take off their masks and shout relatively loudly, or when they are in contact with many people, and decreases when they prefer to be alone.In addition, each node belongs to multiple groups of various sizes. Each group has its own size and activity characteristics to represent classes, commuting trains, sports clubs, family members, and so on. If the group enrollment is large, or if it is a sports club with unmasked activities, the probability of cluster infection within the group will increase.

The paper uses the actual pandemic parameters in Japan retrieved from [3]. The COVID-19 can infect others several days before the onset of obvious symptoms and this characteristic is incorporated in the simulations. The main routes of infection are droplet infection and contact infection. Elderly people are more likely to become seriously ill.

III. GRAPH ALGORITHM STRUCTURE USAGE OF THE ACTUAL PANDEMIC PARAMETERS IN JAPAN

Following [3], it is assumed that the average incubation period is set to be 5 days, and the period of infectious capacity, whether onset or asymptomatic, is set to be 6 days. Furthermore, the simulations expect that the number of days during which the students continue to attend classes at school while retaining the ability to be infected (StayHomeDelay) is 3 days. If symptoms are realized, the child should be isolated at home from then on. After 12 days from the date of infection, the infected student is assumed to be

immune and not reinfected. This corresponds to the fact thatno high school students have died due to COVID-19 in Tokyo so far.

It is presupposed that a total of 10000 people are considered as the class component of the matrix (class Person[10000]) and there are 5000 possible groups in a class component of the matrix (class Group[5000]).Each matrix of human class (person[]) is assigned a flag of off=0/on=1 to indicate the state infection (person[].infected), of incubation (person[].incubation), onset (person[].onset), recovery and immunity (person [].recovered) are assigned. The initial date of infection is set to 1, and total number of infected the days (person[].infectedDays) is updated every day, and the above status flags change according to the number of infected days. The respective settings are: infected=1 (1<infectedDays), inubation=1 (1<=infectedDays<=5, 5days), onset=1 (6<=infectedDays<=11, 6days), recovered=1 (12<= infectedDays). The number of days of school attendance with the ability to become infected was set as a parameter of StayHomeDelay (3days) as described above, which corresponds to a period of 6<=infectedDays<=8.Table 1 summarizes these COVID-19 infection status.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Infected day	Х													
Infection		1	2	3	4	5	6	7	8	9	10	11		
Incubation		1	2	3	4	5								
Onset							1	2	3	4	5	6		
(infection ability)							1	2	5	4	5	0		
Attend class							1	2	3					
Isolation at Home														
Recovered													1	2

Table 1. Time table of COVID-19 infection status

Person[].activity denotes the strength of each individual's unique infectious capacity. The maximum value is 1.0 if that person does not take various possible measures to prevent infection, such as talking at a distance of 2 m, frequently sterilizing hands, wearing a mask, etc. On the other hand, it becomes small if that person takes various measures to prevent infection to the maximum extent possible. Furthermore, the risk becomes smaller if the various infection prevention measures are taken into account to the maximum extent possible.

Each individual (person[]) belongs to multiple groups (group[]), and the total number of groups to which each individual belongs (person[].GroupNumber) is randomly set between 1 and 10, with a maximum of 10, to represent the size of each individual's activity range.For each matrix group class (group[]), the intensity of infection among the members of the group is set as group[].intensity (0~1.0). It will be greater if the ventilation capacity of the activity location is low, or if the activity involves active contact without a mask, such as in a sports club.Infection occurs between members i (person[i]) and j (person[j]) who belong to group k (group[k]), and the probability of its occurrence p(i, j, k) is multiplied by a constant factor MaxCrossInfectionRatio to obtain

p(i, j, k) = person[i]. activity · person[j]. activity · group[k]. intensity · MaxCrossInfectionRatio

The constant coefficient used in the cross-infection capability, MaxCrossInfectionRatio, is normalized based on the effective reproduction number to be specified in advance during the initialization of the setup.

It is assumed that the probability of infection is assumed to be the same value in both directions, and as a result, it is assumed that people with a propensity for easily infected behaviors and environments have characteristics that make them easily infected at the same time. Since each individual person [i] and person [j] belongs to multiple groups, there are n groups of cases where they are together, so the total mutual infection probability is expressed as follows

 $P(i,j) = \sum_{k=1}^{n} [person[i]. activity$ $\cdot person[j]. activity$ $\cdot group[k]. intensity$ $\cdot MaxCrossInfectionRatio]$

initialization

10,000 people were randomly assigned to 5000 groups conditional on each person being assigned to at most 10 groups. Person[].groupMstores the set of group(s) each person belongs to.Next,group[].member[] stores the set of the IDs of the people assigned to each group. For all groups, we calculated the mutual infection probability p(i,j,k) among group members, and finally obtained the mutual infection probability P(i,j) = P(j,i)between all person[i] and person[j].

The total probability of infection for person[i] can be calculated as follows

$$P(i) = \sum_{j=1}^{N} P(i,j)$$

The average value of the cross-infection probability P(i, j) of all members of the group in the initial state multiplied by 3 days, the period of possible infection, is theoretically the effective reproduction number. Therefore, we initially calculated P(i) using MaxCrossInfectionRatio=1.0, and finally normalized using the following formula.

MaxCrossInfectionRatio

$$= \sum_{i=1}^{N} \{ (P(i) \cdot \text{EffectiveReproductionNumber}) / (N \cdot \text{StayHomeDelay}) \}$$

First patients: If the set number of the first patient in the population is very small, for example, one, the infection intensity of this patient person[1].activity is small, the number of groups he belongs to person[1].groupM[] is small, and the infection probability P(1) is small, then, although it is a probability calculation in some cases, the patients are moved to home isolation mode before the infection spreads and the infection does not spread at all. Therefore, we set the initial number of patients to be 10 so that the infection would spread stably.

Infection: To determine whether a patient person[i] infects an uninfected person person[j], if the probability of infection P(i, j) is greater than Rand1, a uniform random number between 0 and 1, then person[j] is considered infected.

P(i, j)>Rand1 : person[j] is infected

Each day, update everyone's infected/uninfected, incubation, onset, quarantine, and recovery status, and calculate the probability of transmission from infected to uninfected.

IV. DISCUSSIONS AND RESULTS



Fig. 1 shows the time history of case 1 and tells that the peak of the epidemic when the number of new cases reached the maximumis 44 days later the new infections is 2.5% at the peak. The day when the number of infected people accumulated to 95% of the final infected people is defined as the convergence day, which is 70 days later, and the total number of infected people was 60%. Table 2 shows the list of the parameters. We set case 1 as the default case and increased and decreased each parameter to examine the effects of parameters' changes on theresults. The changed values from case 1 are highlighted in Table 2.

Simulation parameter	simulation case								
parameter	1	2	3	4	5	6	7	8	9
Population	10000	10000	10000	10000	10000	10000	10000	10000	10000
StayHomeDelay	3	3	3	3	3	3	3	2	4
groupsNumber	5000	2500	10000	5000	5000	5000	5000	5000	5000
maxGroupsNumber	10	10	10	20	5	10	10	10	10
EffectiveReproductionNumber	1.8	1.8	1.8	1.8	1.8	1	3	1.8	1.8

Table 2. The Simulation Parameter of 9 Cases.

A Simulation of COVID-19 Transmission	until the Ste	ady State u	using Graph	Algorithm
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Simulation parameter		simulation case								
results	1	2	3	4	5	6	7	8	9	
max epidemic period[day]	44	44	51	44	57	82	36	63	45	
max new patients ratio[%]	2.5%	2.8%	2.2%	2.9%	1.7%	0.8%	5.0%	1.4%	3.4%	
stable period[day]	70	69	74	66	87	124	53	88	63	
total infected ratio[%]	60%	61%	59%	61%	55%	37%	73%	45%	68%	

Table 3. The Simulation Results of 9 Cases.



Figure 2. Time history of the new patients of 9 cases.

The results show that some assessments can be deducted about COVID-19's peak timing and height.

- 1) Not effective: Reducing the number of whole groups can slightly delay peak timing and lower the height, but it is negligible. Smaller meetings are not effective in preventing infection.
- 2) Effective: Reducing the number of groups a person belongs to, reducing the average effective reproduction number, and reducing the attending class period while having infection abilityare effective.

V. SUGGEST FUTURE RESEARCH, ENHANCEMENTS

Future research would consider multiple starting points, ages, genders, ethnicities, regions, seasons, and vaccine level. These variables can be easily incorporated into our model through the change of the parameter values. This paper dealt with the 10,000 people due to the author's notebook computer's capacity. More people can be examined with a more powerful computer. Furthermore, comparison with results of AI machine learning will be examined.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Toshinari Baba is the single author. Therefore, he did everything such as constructing a model, analyzing the data, and writing the paper. **ACKNOWLEDGMENT**

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THE RESILIENCE OF HOTELS IN THAILAND AMIDST COVID-19 PANDEMIC: A CONCEPTUAL FRAMEWORK

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Abstract - This research combined the factors that have been developed in the literature to construct a conceptual framework for predicting the level of organization resilience of hotel business during COVID-19 disaster. The integrative framework composed of multi-capital (economic, social, human, physic, culture, and technology), multi-management practice (marketing, maintenance,epidemic prevention,human resources, and government assistance), and multi-business information (location,sizing of business,scope of business, andquality level of business). The measurement guidelines of each sub-factor, which adopted from the literature, were provided.First, the frameworkaccording tooveridentified model was presented, business background organization capital and crisis management were defined as independent variable while organization resilience was assigned as dependent variables.Therefore, threetypical research hypothesescan be created. Second, the alternative framework accordance with structural equation model (SEM) was alsoexhibited to the integrity of the analyzed data. The analyzed data of frameworks may help the hotel's leader to plan or develop the disaster resilience of organization.

Keywords - Coronavirus Disease, Crisis Management, Organization Capital, Adaptive Capacity, Planning

I. INTRODUCTION

The first report of COVID-19 disaster was published by the World Health Organization (WHO) in January 2020 [1]. The virus has spread to the global sector across many countries. The global and local health authority provided the guidelines to control the spreading of COVID-19 pandemic including lockdown, social distancing orders andtravel restrictions.Most countries border had closure [2].Therefore, the hospitality businesshasdetrimentaleffect firstand will beone of the last businesses to recover [3].

Jiang and Wen [4] indicated that the COVID-19 pandemic impact immediatelyon the international hotel sector and had long term negative effect. According to UNWTO[5], The tourist and traveler in 2020 reduced by 74% (onebillion people) in comparison with 2019. The value of loss intourism industryis approximately 1.3 trillion dollar or 11 times higher than the global economic crisis of 2009.From the prediction of experts, tourism industry used two-half to four years to recover the business to the same level as 2019 [6].

Regarding the effect of COVID-19 pandemic, the level of organizational resilience of hospitality business especially hotel business has been focused by various research works [7-9]. The business preparedness can be evaluated following three principalattributes (situation awareness, management keystone vulnerabilities, and adaptive capacity) [10-11].Brown et al [12] indicatedthat experienceof crisis had more positively influence onorganization planning. The presence of available resources(multiorganizational capitals) can also help organizations adapt more easily, especially economic and human capital as presented by Filimonua et al [7].The past research [7] also indicated the surprising results that social and physical capitals had limit effect on organization resilience of hotel in Spainbecause of high competitiveness between hotels and novelty of the COVID-19 crisis.

Crisis management is among of the significant elements of organizational resilience plan [13]. According to Deloitte's 2018 [14] global survey, if senior management and board members had been focused on creating crisis plan or simulating crisis, their organization had positive trend to reduce negative impact from crisis. Sengel et al. [15]indicated that COVID-19 pandemic had a significant impact on crisis management of business.Consequently, hospitality various focusedprovided researchworks [16-17] the measurement items for evaluating crisis management. Moreover, Brown et al [18] suggested that the sizing and quality rating, which reflected the business background, may also influenced on organization resilience.

Therefore, the authors created the integratedwhich can use to evaluate the organization resilience through three independent variables including business background, organizational capital, and crisis management. There are two types of framework model: (1) overidentified model and (2) structuralequation model. The conceptual frameworks proposed in this workhas an advantage to managers or leaders of hotel business for exploring preparedness of business under pandemic.

II. MEASURABLE ITEMS FOR A CONCEPTUAL FRAMEWORK

The research compiled the factors, which have been proposed in the past research works, to exhibit a conceptual framework for forecasting the resilience of hotel businesses under COVID-19 situation. According to the literature, three main variables includingbusiness background, organizational capital, and crisis management influenced on organization resilience. The details of each variable are as following.

2.1. Business background

According to the suggestion of Brown et al [18], sizing and quality rating of hotel may influence hotel resilience. The hotel sizing can beclassified by the number of rooms [19-21].Large hotels may recover quickly from the abundance of resources, on the other hand, they had burdensome responsibilities. The geographical scope of business operations [19, 21]couldreflect theability to overcome the crisis. The presence of networking in chain systemcaused mutual aid.Moreover, the different hotel locations [21-22]also effected to recovery times because of the distinction of the client groups and resource accessibility. The quality of hotel can be observed from facility and service. The star rate often was used to grade the hotel [21-22]. Regarding to the Government Savings Bank (GSB) research [23], under crisis 4-5 stars hotelwere taken away the customer by the 3- or lower-stars hotel because of consumer purchasing power, however, higher star hotels can stay solvent longer than lower star hotels. It meant that rating of hotel influenced on organization resilience. The measurement items ofbusiness background are presented in Table 1.

2.2. Organizational capital

The capitals displayed the presence of available resources or creating of additional resources. The resources can be a touchable item (money), service, human skill and sensibility (intangible), and potential. The combination between veritable resource and potential leaded to withstand and recover form unforeseen circumstances [18, 24]

For the organization, Brown et al. [18] presented and concluded the theme and concept of fiveimportance capitals using in hotel sector. The economic capital was considered about financial resource, financial strength, and variety of income. The social capital was focused oninside and outside social connection [24-25]and alsoconsidered the integrationbetween the outside and inside view [26]. Trust in stakeholders and in actual information should be evaluated. The assistance between organizations had an influence to withstand the crisis [8].The human capitalhad an important role to drive the business. Experience, knowledge, skill, and adaptation of leader or employee in the organization can regain the business from crisis [9, 24-25]. The physical capital can be described in term of ability to changebusiness environment whichdepended on the existing infrastructure, site location, and some equipment [24-25, 27]. For the cultural capital, the literature [9] indicated that it related to the socialcapital, however, the distinction source can be founded in the context of hotel [18]. Presently, the technologies had a role in hospitality business. The combination of equipment andproficiency of worker revealed the technological capital of the organization[28]. The conclusive measurement of organizational capital presents in Table 2.

2.3. Crisis management

The crisis was described as the surprised event that occurred in the unplanned situation. The crisis gave the danger to people and things in the organization [29]. The initial crisis management practices with four main categories and 21 measurement itemswere proposed by Israeli and Reichel in 2003 [30]. Marketing, maintenance, human resource, and government assistancewere used in the framework to study the Israeli hospitality industry [30], restaurant industry [31], Indian luxury hotels [32], and travel agency sectors [33]. These practices were also adopted with addingEpidemic prevention practices to study the hotel in Macau under COVID-19 pandemic [17]. Five factors of crisis management can be evaluated by the proposed measurement tools in Table 3.

2.4. Organization resilience

Theorganization resilience was divided into four phases [29] including a disturbance phase, an absorption phase, a renewal phase, and a appropriation phase. Three factors due torelative overall resilience (ROR) model [10], which composed of situation awareness, management of keystone vulnerabilities, and adaptive capacity [9-10], were proposed to explore the organization resilience and adjusted. The adjusted models with 2 factors including adaptive capacity and planning (Table 4) can be usedeasily to evaluate the organization resilience.

III. A CONCEPTUAL FRAMEWORK

In this research, two conceptual frame works were proposed consisting of overidentified model (OM) [35] and structural equation model (SEM) [36-37]. The conceptual framework consisted of multi-capital (economic, social, human, physic, culture, and technology), multi-management practice (marketing, maintenance, epidemic prevention, human resources, and government assistance), and multi-business information (location, sizing of business, scope of business, and quality level of business) as presented in Table 1-4. The Resilience of Hotels in Thailand amidst COVID-19 Pandemic: A Conceptual Framework

Categories	Measurement
Location (LO)	Hotel locations are categorized into 5 groups: (1) Downtown hotels, (2) Sub- urban hotels, (3) Resort hotels, (4) Airport hotels, and (5) Motels.
Sizing of business (SI)	It can be classified by number of room (<25 for small hotels (independent, economy, and motel), 26-100 for medium hotels, $100 - 300$ for large hotels, and > 300 for very large hotel (upper upscale and luxury)).
Scope of business (SB)	Classification based on ownerships: (1) Independent hotel, (2) Management contacts, (3) Franchise, (4) Referral groups, and (5) Condominiums.
Quality level of business (QB)	The hotel quality wasrepresented by 5 scale stars or group, which measured from facility, service, and price.

Table1: Business background

Categories	Measurement
Economic capital (EC)	It is essentially the quantity of capital required for a financial institution to be viable in light of the riskiness of its assets and capital.
Social capital (SC)	It is concerned with the value of social networks, both inside (trust in stakeholders) and across companies (helping each other's), as well as the bridging of organizations.
Human capital (HC)	Human capital is recognized for its ability to improve worker performance, prior experience, and benefit the company.
Physical capital (PC)	It is a physical valued asset that may be utilized to mitigate disasters, such as a safety system, a diverse supplier base, and enough infrastructure.
Cultural capital (CC)	In both functional and constituent dimensions, cultural capital is a necessary component of culture. It is an expression of people's conduct within the company.
Technological capital (TC)	The existence of an innovative product, processes, and product technology to reduce cost, time, and catastrophe is referred to as technological capital.

Table2: Organizational capital

Categories	Measurement					
Marketing practices (MK)	Marketing combined with other forms of marketing. It refers to accomplishing the organization's marketing goals.					
Maintenance practices (MT)	Minor equipment maintenance is conducted utilizing procedures that do not need a thorough technical grasp of the operation and design of the equipment.					
Epidemic preventionpractices (EP)	The procedure to be followed in the event of an outbreak is addressed in epidemic control.					
Human resources practices (HP)	It is critical from the standpoint of strategic human resources, which refers to improving its effectiveness in the face of COVID-19.					
Government assistance practices (GA)	During this time, the government aided the group by launching a government project, providing subsidies, and suspending debt payments.					

Table3: Crisis management

Categories	Measurement
Adaptive capacity (AC)	The organization has ability to adapt their capital for withstand under disaster. The environment of organization (human and apparatus) can be changed to support new business direction.
Planning (PL)	The organization plan the overall situation and defined the planning strategies. Also, the organization has proactive posture for finding the external resources to recovery.

Table4: Organization resilience

The Resilience of Hotels in Thailand amidst COVID-19 Pandemic: A Conceptual Framework



Fig. 1. Organization resilience evaluation conceptual frameworkaccording tostructural equation model.

For over identified model, the path analysis was implemented inference via statistics. The organizational capital, business background, and crisis management were assigned as independent variables while organization resilience was defined as dependent variable. The framework of this model can be drawn as shown in Figure 1 (Dash-dot red lines).According to the conceptual framework, three main research hypotheses can be provided including (1) How much influence does organizational capital have on organization resilience and which capital has the most influence? (2)How much influence does management of crisis have on organization resilience and which practice has the most influence? (3) Does each category of business background influence on organizational capital? Two statistic tools were used to investigate the hypotheses. One is multiple-linear regression. The relationship between OC and OR provided regression equation with six sub-variables, while 5 sub-variable of regression equation were observed for the relationship between CM and OR. The other is analysis of variance which could be implemented in two types of statistical tool: T-test was used for two group analysis and ANOVA was applied for higher two group analysis. The influence between each group within business background category and OR were examined.Before multiplelinear regression analysis, the normality, linearity and multicollinearity must be checked. In some case, the factor analysis was also implemented. The KMO (Kaiser - Meyer - Olkin) and Barlett's Test of Sphericity were adopted to prove the data suitability first. Then, the extraction process was conducted to renew groups of factors.

For structural equation model, the framework could be illustrated as presented in Figure 1. The framework was combined by two model including

SEM and measurement model. In measurement model had latent variables and observed variable. For example (dot box in Figure 1.), latent variable was the business background, which was an exogenous type. While sub-variables including location, sizing of business, scope of business, and quality level of business were considered as observed variables. Another latent variable, comprised of organizational crisis management, and organization capital, resilience, were endogenous type. For SEM (dash box in Figure 1.), business background and organization resilience were taken into account as latent variables while organizational capital and crisis management were regarded as mediating variables. Eight hypotheses could be defined: (1) BB directly affect to OR; (2) BB directly affect to CM; (3) BB directly affect to OR; (4) BB indirectly affect to OR through OC; (5) BB indirectly affect to OR through CM; (6) OC directly affect to OR; (7) CM directly affect to OR; and OC directly affect to CM, which could be analyzed via dependent statistic technique.

The proposed frameworks provide a detailed to assess the resilience of organization which could be used during or after the situations depended on contexts of measurement questions. Moreover. the comprehensive elements, which contributed to organization resilience, were also evaluated through the frameworks. The results of analysis could present the strength of weakness of the organization, which helped the manager or owner to set the way of business after disasterpassed. Furthermore, these frameworks may be slightly customized to adopt to hospitality other business (e.g. restaurant. entertainment, and other tourism-related services) or other disaster. The observed variable should be added or removed to develop greater measurement items in further research.

IV. CONCLUSION

This research combined the 17 observed variables, which have been identified in the literature, to create the two conceptual frameworks accordance with overidentified model and structural equation model. Four latent variables consisted of business background, organizational capital, crisis management, and organizational resilience were evaluated to assess the COVID-19 disaster resilience of hotel business.

The first proposed framework was simplicity. Only one step of analysis was used via inference statistics (regression and analysis of variance). The second framework was developed to investigate both direct and indirect influence between variables, which was analyzed by dependent statistic technique.

The manager or owner of hotel businesses could be adopted these integrative frameworks torecognize their organization resilience during or after COVID-19 disaster and also understand the composition of disaster resilience. Leader of hotel could plan or develop their organization (capitals and management method) through analyzed data of sub-variable to increase the organization resilience.

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A POST-PROJECT EVALUATION OF THE TARRED ROAD PROJECT ON THE LIVELIHOOD OF LOCAL RESIDENTS: A CASE STUDY OF MALAMULELE REGION IN VHEMBE DISTRICT

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Abstract - There is poor post-project evaluation of road infrastructure development projects in South Africa's rural settlements. Therefore, there is lack of feedback on the impact such developments have on rural communities. This negatively impact future development policies in these communities due to uninformed and uncoordinated interdepartmental initiatives. With a clear post-project evaluation framework, rural livelihoods are likely to improve. This study sought to investigate the impacts of tarred road on the livelihood of Malamulele local residents in Vhembe District. The tarred road under study stretches 7.7km from Punda Maria into the village and back to the Punda Maria. The research's major aim was to investigate how the tarred road project has impacted the livelihoods of the residents of Malamulele region in Vhembe District. The secondary objectives were to examine livelihoods prior to the tarred road project, assess the post project livelihoods of the residents and lastly to make recommendations on how to maximise the benefits from the tarred road while minimising threats and risks. The study took an approach of a case study as the methodology. It made use of mixed methods to collect data whereby both quantitative and qualitative data were collected. The primary data was gathered through questionnaires consisting of both opened and closed ended question and were distributed to 110 local residents of Malamulele region. The researcher ensured that the consent of the participants is obtained prior to collecting data. This was done by presenting participants with adequate information about the research study and their rights as participants so that they can make an informed, voluntary and fair decision to engage in the study. The study found that residents are partly satisfied with the impacts of the road as some of their initial issues were not addressed. The study revealed that the community still struggles with public transport and is paying higher transport fares in order to access shops and social infrastructures. On the positive side, the community has found the road to be beneficial in terms of accessibility during rainy season, and dust has also been eliminated.

Keywords - Project Management, Post Project Evaluation, Livelihoods, Tarred Road, Road Infrastructure.

I. INTRODUCTION

A well-developed transport infrastructure is a prerequisite for economic growth and poverty alleviation (Starkey & Hine 2014:14-22). It is an essential component of national economies and plays a significant role in spatial relations, assisting in the creation of valuable links between regions and economic activities, as well as between people and the rest of the world (Andrews, Braimah and Vincent 2018:169-171). As a result, many third-world countries have several infrastructure initiatives (projects) aimed at improving the livelihoods of their citizens (Otieno 2000:15-17). These projects receive investments (monetary investments), and it is therefore critical to conduct post-implementation evaluations of these projects so that stakeholders can see the value of their funds (Ibid.). The importance of post-project evaluation for investors is that it allows them to determine whether projects met predetermined goals (Khandker, Koolwal & Samad, 2010).

The Vhembe District has a total of 1329.46 kilometres of tarred roads, with a backlog of 2243.89 kilometres (Vhembe District Municipality 2016:95-97). Many of the villages in the district, including the one under evaluation, have only gravel roads. The movement of traffic and climatic changes over time cause gravel road gravel loss, resulting in dust

generation, safety and health hazards, discomfort and nuisance, air pollution, and road inaccessibility during the rainy season (Rajkamal, Dinesh, Rohith, Chowdary and Prasad 2016:82-85). The effects of bad roads in South Africa's rural communities cannot be overstated (Andrews et al., 2018:169-171), and despite the topic's importance, there is some dissatisfaction with the evidence to demonstrate the impact of rural road investment. Rural road impact studies have had little influence on the planning and selection of standards for rural road investment due to a lack of a consistent analysis (Hine, Abedin, Anderson, Stevens, Airey and 2016:3-9). Notwithstanding the perceived effects of bad roads, researchers and scholars have not adequately addressed the issue, necessitating empirical research to determine its effects on the livelihood of residents.

II. RESEARCH METHODS AND DESIGN

2.1 Research Design

Trochim (2006) defines research design as being the overall strategy that an individual chooses to incorporate various elements of the study in an intelligible and logical way. According to Akhtar (2016:70-76), there are four types of research designs namely; descriptive, exploratory, explanatory and experimental. This study is both exploratory and descriptive in nature. According to Dowling (2014),

exploratory design is used to explore and find thoughts and perspectives, while descriptive design provides explanations of factors from which the research problem can be resolved (Adepeju, 2017). These two designs were used by the researcher to explore and describe the experiences of Malamulele residents regarding the upgrade of their local road. These research designs allowed the researcher to describe and explore the insights and experiences into how residents were impacted by the tarred road.

2.2 Setting

The village under study comprised of two high schools and two primary schools and one public clinic. According to Census 2011 (StatsSA 2011), the village consisted of 4 452 total population of Xitsonga speaking people with the highest percentage constituted by women (56, 1 percent). Young children of the age 0-14 years constituted 38.8 percent, the working age (15-64) marked up the largest percentage of the population (55 percent) with elderly people (65+) constituting the lowest percentage of the population (6.1 percent) (Ibid.).

2.3 Research Methodology

Walliman (2017) describes research methods as the tools and methods used to conduct a research study. The researcher utilised mixed methods (quantitative and qualitative methods) of collecting data. Ihuah and Eaton (2013: 938-940) assert that the case study research allows the researcher to use different sources and methods to gather information. Mixed methods enhance strengths and decreases the constraints of individual methods and add to a common knowledge of the phenomenon of research (Wium & Louw, 2018:1-8). Moreover, the mixed methods approach also provides researchers with the opportunity and independence to address the research questions that other methodologies cannot address (Ronald, 2016).

2.4 Study Population and Sampling Strategy

The target population for this research study were people from the Xitsonga-speaking village (a sample was taken from residents who had lived in the village for more than 15 years and were also between 18 and 65 years of age) in Malamulele region of the Vhembe District.

The researcher made use of purposive sampling to select a sample of residents who had lived in the village for more than 15 years and who were also between 18 and 65 years of age. Amin as cited by Kameraho (2015) clarifies that purposive sampling is useful in selecting individuals with unique information or experiences about the problem under study.

The second sampling method used for this study was a random sampling. Welman, Kruger and Mitchell as referenced to by Khandker et al. (2010) affirm that the use of random sampling grants every individual in the population an opportunity to be part of research regardless of their gender, race and religion. The researcher utilized simple random sampling method to select participants within the defined representative sample (participants who lived in the village for more than 15 years and who were also between 18 and 65 years of age).

The sample size is a significant feature of any empirical study in which the goal is to make inferences about a population from a sample (Taherdoost, 2017:237-238). It has been recommended by Graff (2016) that the sample size of mixed methods be sufficiently large to represent the target population; generally, at least 50 units. Therefore, a sample of 130 residents was acceptable for this study. Moreover, the researcher also considered the availability, responsiveness, quest for knowledge and the willingness of members to participate.

2.5 Data Collection Methods

There are many ways of collecting data from participants; the researcher made use of secondary and primary data and are described in depth below:

2.5.1 Secondary Data

Secondary data is the kind of information that other scholars have already gathered or generated (Ajayi, 2017). This research study utilized literature from scholarly articles, municipal documents, books, and government websites to enhance the findings of the study and also gain more understanding of the research project. The researcher used secondary data sources to discover what other scholars have established in the same or similar field and to study their methodological approaches to these studies. Information obtained from secondary data sources made it possible for the researcher to formulate the hypothesis and also to use it as a reference point.

2.5.2 Primary Data

The researcher made use of structured questionnaire (consisting of open-ended and closed-ended questions). This method was selected due to its advantage denoted by Bhattacharrya (2006) that a questionnaire is a faster and cheaper way of gathering information from the sample. The questionnaire survey was designed in such manner that it allowed the researcher to assign numerical values (using a Likert scale) to measure and analyse the significance of specified behavioural anticipation by the respondents. In this manner, the researcher was able to obtain relevant information that enabled her to analyse and organise data therefore reach a conclusion.

2.6 Field work

The researcher personally distributed questionnaire surveys to the community members (including motor vehicle owners' residents) and participants were expected to complete these questionnaires themselves based on their experiences of the newly tarred road. Illiterate and elderly residents were assisted by the researcher in completing the survey. Questionnaires were chosen to be an ideal method of collecting data

for this research project because they have an advantage of collecting an enormous amount of data in a relatively short period of time and that they can be analysed using different software of analysing data (Frechtling, Mark, Rog, Thomas, Frierson, Hood, Hughes & Johnson, 2010).

2.7 Data Analysis

The quantitative data obtained was analysed, interpreted and presented in graphics and tabular form using a software program called Statistical Package of Social Studies (SPSS). According to Landau and Everitt (2004), SPSS is a powerful and comprehensible program of analysing and manipulating quantitative data. However, prior to entering data on the software program, the information was sorted to remove errors that were present during the collection of data. The qualitative data was analysed and then coded. As Maphosa (2014) quotes Cornwell, this method is among the most significant tasks in qualitative research.

2.8 Ethical considerations

This research took into consideration the rights of every human stipulated by Locke, Spirduso and Silverman (2007) which says every person has a right not to be used by other people. The researcher obtained the consent of the participants by presenting them with adequate information about the research study and their rights as participants so that they can make an informed, voluntary and fair decision to engage in the study. The participants were also informed that they can withdraw from the survey at any time. Permission to conduct interviews was requested from the participants and a consent letter to conduct research on the village was sent to the village officials.

Confidentiality ensures that the information of the participants is safeguarded by maintaining privacy and anonymity with respect to the identification of the participants and other private information (Thambura, 2016:42-43). All information provided by the participants was treated as confidential and personal information such as identification numbers, names and residential addresses remained anonymous.

III. RESULTS AND DISCUSSIONS

3.1 Transport

3.1.1 The total number of people using public transport on daily basis.

Options	Number	Percentage
YES	81	86%
NO	13	14%

Table 3.1.1 above indicates that the highest number of respondents (86 per cent) make regular use of public transport. Meanwhile, 14% use their own transport. 3.1.2 The type of public transport used by residents.



The diagram above (Figure 3.1.2) reveals that the most used public transport in this village was a taxi, with 69% of the respondents. The least proportion (13%) of them used their own transport (either a bakkie, motor cars or bicycles). Only 18% of those surveyed used buses.

3.1.3 Transport waiting time before construction of tarred road



Figure 3.1.3 reveals that most respondents would wait up to 1 hour 30 minutes (63%) for public transport prior to the construction of tarred roads. The remaining 37% indicated that they would wait longer than 1 hour and 30 minutes. In addition, this figure indicates that transport was a problem, and this may have been due to the inaccessibility of the gravel road during rainy days and potholes. Most of the respondents confirmed that public transport was not reliable before and most of the time they would end up walking to the nearest town or giving up and returning home. Nemvumoni, (2017) argues that transport is primarily determined by road conditions and that sometimes road conditions can be so poor that certain modes of transport cannot be reached by road.

3.1.4 Travelling time after the construction of tarred road.



The transport waiting time for residents after the development of a tarred road is shown in Figure 3.1.4 above. According to this statistic, the highest proportion (66%) of residents indicated that they wait 30 minutes or less for public transport. Only 34% of respondents mentioned that they wait more than 1 hour and 30 minutes for public transport. This means that there is a correlation between road conditions and accessibility of transport. Post project studies such as those conducted by Mu and Van De Walle (2011:729-734) associated improved/paved roads with a decrease in travel time from the respective villages to existing markets. It has also been commonly believed that, if good roads exist, market forces would respond to demand for transport being met by transport operators (Starkey and Hine, 2014:14-22). Compared to the Figure 3.1.3 above, there seems to have been improvement in terms of the waiting time; residents wait less time for public transport as compared to before the construction of tarred road.

3.1.5 Access to Transport

According to Starkey and Hine (2014:14-22), effective transport infrastructure is a necessary condition for economic growth and sustainable development. Residents of the village under study reported that previous gravel roads were extremely difficult to access during rainstorms; therefore, public transport was scarce and unreliable. Figure 3.1.5 below shows the viewpoints of residents on accessibility of public transport, if there is a new tarred road in their village:



The figure above highlights that 44% of respondents were of the opinion that the new tarred road had enhanced the accessibility of public transport. Nevertheless, 27% of respondents believed that public transport was still inaccessible. A percentage of 29 respondents were unable to give their views on the matter.

3.1.6 Transport costs comparison before and after the construction of tarred road



Previous studies, such as the ones conducted by Robbins and Tran (2015:8-13) have identified a relationship between tarred road, vehicle operating costs and transport costs. That is why the survey investigated this aspect. According to the above statistic, 54% of respondents believed transport costs were still high. Meanwhile 39% of the respondents claimed that the price of public transport had not changed relative to the previous time they had gravelled road. In this respect, the least percentage (7%) could not adequately state their opinions.

3.2. Road quality

3.2.1. The quality of tarred road provided in the village



Figure 3.2.1 above illustrates the quality of the tarred road as the residents perceive it. According to Mamabolo (2013), the quality of road infrastructure remains a challenge in most rural areas because the road accident record is still high in South Africa. The researcher therefore investigated the quality of the new tarred road in the village, in order to obtain accurate information on the sustainability and satisfaction of residents about the quality of the road. As depicted in this figure, 61% of residents were not satisfied with the quality of the tarred road delivered by the Municipality and ere of the opinion that this

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road was not going to be sustainable. Approximately 22% of respondents were pleased with the quality of the road received and the remaining 17% could not clearly express their views in this regard. 3.2.2 Road Maintenance



Figure 3.3 herein shows the results regarding the municipality's road maintenance in the village under study. The researcher investigated this question in order to gather information on how the municipality performs to ensure that roads remain in good condition and are accessible to residents. When roads are not maintained regularly, they become impassable and damaged (Hine, Abedin, Stevens, Airey and Anderson, 2016:3-9). According to this statistic, the majority of respondents (85%) agreed that the municipality did not maintain the roads in their village (the previous gravel road was not maintained regularly, so access on this road was difficult, and since the implementation of the tarred road, there has not been any maintenance of the road). Meanwhile, 30% of respondents acknowledged that the municipality is routinely engaged in maintaining the roads. Of the 94 respondents, just 10% were indecisive on this question and could not accurately provide answers on this question.

3.3 Current road condition

As posited by Blöndal cited by Ferf, Hilhorst and Mashanda (2014:10-18), roads are anticipated to have positive impact on the livelihoods, social and economic wellbeing of the citizens. This study explored the current status of the tarred road provided by the local municipality to the village in order to obtain accurate information and to find out whether the condition of such roads has an impact on the livelihoods of residents.

Figure 3.4 Current Road Condition Figure 3.4 Current Road Condition Strongly Disagree Disagree Neutral Agree Strongly Agree

According to Figure 3.4, 58% of respondents were not satisfied with the current condition of the tarred road. Respondents mentioned that the road was unfinished, and drivers were attempting to use the road regardless of its faults; posing a danger to pedestrians and to their vehicles. A percentage of 28 respondents believed that the tarred was in good condition and thus satisfied with the road. Whereas the smallest percentage (14%) remained neutral to the question; could not properly decide whether they were content with the current status of the tarred road.

3.4 Socio-economic activities

3.4.1 The tarred road resulted in economic benefits to the community

Road infrastructure has been shown to be capable of reducing poverty; affecting the livelihoods of local residents through increased market access and lower priced transport (Ferf et al. 2014:10-18).The research study conducted by Intermediate Technology Transport as cited by Booth, Hanmer and Lovell (2000) in the Philippines has found that there is a relationship between the access to social and economic services and income level; Improved access to the markets ultimately improves the household income.



Figure 3.5.1 above demonstrates the results from the tarred road about the economic benefits of the residents. In this instance, the general percentage of respondents (62%) acknowledged that the tarred road benefited them economically, while only a few respondents (23%) disagreed that this intervention had an economic impact on their livelihoods. The remaining 15% could not indicate whether they benefited economically from the new tarred road. 3.4.2 The project provides for the needs of the community

Strongly Disagree

Strongly Agree

Disagree

■ Neutral

Agree

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This question was posed in order to analyse the perceptions of residents regarding their demands on the tarred road provided. As shown in this figure, most respondents (61%) were of the opinion that the tarred road has met their community needs. Some of the respondents indicated that their initial problems (dust, mud and transport) had been resolved by the tarred road provided. The statistics also show that 15% of respondents were not satisfied and believed that the road had not met their needs as a community. Only 24% of the respondents were unable to provide the appropriate responses to the question.

3.4.3 Access to government facilities

Numerous scholars have connected newly constructed roads with increased access to public infrastructure; Van de Walle, Booth, Hanmer and Lovell, Musekene, and many others. The figure below outlines the findings on the accessibility of the social infrastructure by local residents provided that they have a newly tarred road in their village:



This figure (Figure 3.4.3) above depicts that the vast majority of respondents (42%) were unable to provide adequate information on their access to social infrastructure. Meanwhile, 38% were confident that their access to social infrastructure had improved significantly from the previous situation. These participants have indicated that they would now reach out to ambulances in emergency times. Very few respondents (14%) claim that there has been no change in access to social services.

3.4.4 Employment after the construction of tarred road

Figure 3.4.4 below shows the findings on the employment of residents following the construction of tarred roads:



According to the above figure, 68% of the respondents indicated that residents did not receive any kind of employment after the tarred road had been constructed. The respondents also indicated that they expected to be employed in the maintenance of the road or other road-related jobs. Approximately 19% of respondents agreed that other local residents were employed after the construction of the tarred road, while 13% of respondents did not have a definitive opinion as to whether or not local residents were employed after the operation. 3.4.5 Improved social lives



Figure 3.4.5 above indicates that the majority (67%) of respondents observed a shift in their social lives after the tarred road was constructed. The respondents have mentioned that they can now visit their relatives in other cities, and they can go out at any time irrespective of weather conditions. Others have even said that they can now workout and participate in enjoyable activities. Only 25% of respondents agreed that this new path has had little impact on their social lives, while 8% could not offer their views in the same way.

3.5 New businesses



As Van de Walle (2008:15-20) points out, one of the medium-term effects of road construction is the emergence of new businesses in the area. As a result, the researcher explored the views of the respondents on the emergence of businesses in the village since the road was upgraded to tar. According to the figure above, the highest percentage of respondents (87%) reported that there were no new businesses in the village. Meanwhile, 22% of respondents were not reasonably able to determine their responses. The remaining 6% of respondents were confident that there were new businesses in the village.

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3.6 Safety and Traffic

3.6.1 Vehicle Traffic

A reduction in vehicle running costs (due to better road surface area) could lead to increased traffic (Norman 2013:5-11). This question was posed to explore the perceptions of residents about the movement of vehicles and how this could affect their livelihoods. Figure 3.6.1 below shows the findings on vehicle flow after the road has been upgraded to tar.



As depicted in the figure above, the majority of respondents (93%) acknowledged that the number of cars on their roads had increased significantly. They also said that the number is growing even higher during the festive season. This may mean that the road has had a positive impact on residents' wellbeing by improving road accessibility at any season and reducing vehicle running costs. Only 4% of the respondents were indecisive and the remaining 3% believed the number of cars using the road had not increased.

3.6.2 Safety use of the road by school children



The above figure presents the findings on the safety of school children using tarred roads. According to these results, 63% of the respondents agreed that making use of the road without guidance was not safe for school children. They also mentioned that primary pupils needed a senior individual to help them cross the road. Approximately 19% of the respondents agreed that making use of the road was safe for school children, although 8% of respondents were unable to clearly state their views on this matter.

3.6.3 Safety signs on the road



This figure shows that the safety signs on the tarred road were put in place, with 81% of the respondents agreeing to the question. Few respondents (10%) disagreed with the question justifying their responses by claiming that there were missing and wrongly located safety signs and that may lead to accidents. The remaining 9% respondents were unable to answer this question objectively.

3.7 Bad Roads

The researcher identified issues faced by residents prior to the construction of tarred road. This information was collected from the respondents in order to judge whether their issues have been resolved.

- a. Multiple accidents
- b. Mud
- c. Potholes
- d. Lack of service from the Municipality
- e. Lack of Transport
- f. Lack of Place to exercise
- g. Rape
- h. Inability to access to Ambulances
- i. Could not go to school
- j. Inability to access to government facilities

IV. DISCUSSION OF KEY FINDINGS

In this chapter, results presented on the previous section are discussed and summarised.

4.1. Transport

The findings of this study revealed that the most used public transport in this village is a taxi, followed by a bus with few residents utilising their own modes of transports (own vehicles, bicycle and motorcycle). According to Lu, Rohr, Hafner and Knack (2018), transport cost can be affected by the quality of infrastructure and there is an existing and rich information demonstrating a decrease in direct transport costs due to improvements in transport infrastructure. Nevertheless, residents have revealed that the cost of transport is still a major concern in the village.

As stipulated by the residents, most of the issues such as dust, mud, vehicle operating costs etc. were solved. One of their major concerns with transport is the cost. The findings of this study revealed that cost of

transport is considered to be expensive due to the fact that there are no taxis directly from their village to the larger town; locals need to consider taking two taxis in order to get to town, which increases the taxi fare. High transport costs are therefore of concern since they can compromise the ability of poor households to access services, they need to increase their livelihoods, which can translate into improved living conditions according to the World Bank cited by Venter (2011:125-130). Residents anticipated good transport system with low or affordable transport fares and high fares are negatively impacting their livelihoods as they suppress their monthly expenditure. Transport affordability is of the utmost importance in the context of market access, access to schools, emergency, social infrastructure, economic growth and households' financial being (Porter 2014: 29-33). Higher transport fares may compel residents to walk from their respective villages to the nearest town, from one village to another and from their villages to school, which places an additional financial burden to them and their families.

4.2 Road quality

This study has found that the quality of the road is not satisfactory to the residents. Residents have mentioned that the road has cracked, bridges, speed humps and kerbs are not completed, and the road is too low to the point that sand is washed over the road during rainy days. These challenges can negatively impact the community as a whole; they pose a threat to safety and may lead to accidents. A study by Haulle and Kisiri (2016:256-260) concluded that road accidents were induced by poor infrastructure, legal impunity, ineffective regulation, incompetence and negligence by drivers, lack of road safety education and road signs, overloading of vehicles and corruption. In addition, negative road engineering factors can directly cause an accident, particularly where certain elements of the road environment mislead a road user and thus causing human errors (Ahmed 2013:20-23).

In the case of the community's livelihood, road accidents can have a detrimental impact on food security, which eventually affects access to basic foods, as they can lead to injury, job losses and mortality. This is briefly clarified by Gebru (2017:18-22), who argues that road traffic accidents are a serious burden on the livelihood of victims and their families; their income is negatively affected, particularly when the family losses a bread winner or cares for the disabled due to a road accident.

4.3 Socio-economical activities

Most residents were very positive and satisfied in terms of the access to socio-economic activities since the construction of the tarred road. Public transport may be an issue; however, acquaintances with vehicles are now able to reach them. Further, the road has improved the access to other villages and nearest town in terms of safety. That is, the bush has been cleared and it is now safe to walk from one village to another. Accessibility to emergency services has also improved; the residents have indicated that ambulances can reach them at any weather condition. Moreover, residents have specified that their ability to socialise with their friends from other villages has now improved; they can visit each other at any time without stressing about mud and dust. Others have indicated their ability to exercise (jogging in particular) which was not easy prior to the construction of this road.

Many residents anticipated some sort of employment after construction of the tarred road and according to the results of the study; this was less likely to happen. This is attributable to the findings of the research study by Musekene (2010:38-44) which clearly states that jobs are created not only during the execution of the project, but also through the maintenance and operation of the road after its completion.

As Van de Walle (2008:15-20) points out, one of the medium-term effects of road construction is the emergence of new businesses in the area. As a result, the researcher explored the views of the respondents on the emergence of businesses in the village since the road was upgraded to tar. According to the results of this study, large number of respondents is of opinion that there are no new businesses in the area as a result of this intervention. However, few respondents have mentioned that there are few car washes on the side of the tarred road mostly functional and profitable on festive seasons. There is, however, a social infrastructure (Home Affairs) that came about due to this intervention. This will add to the employment rate of the community as the researcher believes that employees will be sourced from the nearest villages including the one under study.

4.4 Safety and Traffic

The issue of safety and traffic in this research was probed to gather information on the safety of residents to use this new road. An increase in traffic has been noted, with increased flow of vehicles during the festive season. The road has permitted vehicle owners to use the road at any time and in any weather condition and has also reduced the operating costs of vehicles. As the majority residents have indicated that there are missing and wrongly located safety signs, this may pose danger to school children crossing and walking on the road. Children at primary level may need a senior person to assist them to cross the road. Further, the findings have stated that there is no pedestrian walk and therefore it is considered crucial for high school learners to be very cautious and vigilant when walking on the road to school.

4.5 Bad roads

From the findings provided in the previous chapter, the study found evidence of the influence of poor

roads on the livelihoods of community members, the transportation and maintenance of vehicles in the village of Malamulele. Roads were not accessible during rainy days and people were therefore unable to access transport. The maintenance and operating costs of the vehicles were costly and had an impact on transport costs as well. Bad roads not only affected transport fares and accessibility, but also the health of community members was at risk due to the enormous amount of dust created by road vehicles. Dust is commonly associated with health problems such as and hypersensitive asthma. flu pneumonia. Maintenance of the gravel road by the local municipality was very lacking.

V. RECOMMENDATIONS

Current government and decision-makers need to implement innovative policies on road infrastructure in the District in order to accelerate the appropriate growth that the District deserves. The Government must always review the reports (such as post project evaluations, monitoring and evaluation reports) in order to verify if the initiatives being undertaken are being carried out correctly and to ensure that the evaluation of standards is the number one priority. Government planning departments should give priority to investment in road infrastructure in rural areas, as this is where the plight of the disadvantaged is specifically addressed, by providing market and service access, lowering transport costs and promoting economic development. The appropriate bodies responsible for road infrastructure planning, development and maintenance should concentrate on converting existing gravel roads to tarred roads, since many roads are still unpaved. It is crucial that the repair and maintenance of road infrastructure is not ignored due to the emphasis on the building of new roads, as this reverses the benefits of the initial investment over time. It is hoped that the adoption of these recommendations will go a long way towards pushing transportation system further and will also contribute to bolster the economy of the provinces and the country, thus ensuring that citizens' livelihoods are strengthened.

VI. CONCLUSION

Upgrading the gravel road to tar has brought many improvements to the community, but according to the results shown in the previous chapter, the results have not been as expected by the residents. The residents anticipated some sort of employment, development of shops and pedestrian walks, social facilities such as gymnastics, library and, finally, cheaper transport. There is no question, however, that the tarred road has brought benefits to the Malamulele area of the Vhembe district. Furthermore, the greatest benefits are typically experienced when road infrastructure projects are made in combination with other investments.

Positive effects of the tarred road

The introduction of tarred roads has greatly improved the socio-economic conditions of the community members. Examples can be taken from the results of the study, such as increased physical activity, small business start-ups, access to roads in any weather condition, safety in terms of walking from one village to another and the introduction of social infrastructures such as home affairs. Transport is available at any time of the day and dust has been minimized. In addition, car owners spend less on repairs and running expenses. Also, the tarred road has positively contributed to the reduction in travel time.

Local members have also mentioned that they can now walk from their respective town to the nearest town and visit their relatives from other villages as well. Others have reported that it is now easier to go out to meet friends and that emergency services can now reach the villagers.

Negative impacts of the tarred road

Transport fare has increased due to the use of several modes of transport to get to the central town. Residents have also noticed a lack of road signs, which could pose a danger to school children crossing the road. The road has incomplete bridges and speed humps and has not been maintained since its completion. The residents also noticed the poor condition of the road; they implied that the road was too low, and, during rainy days, the sand washed on to the road and made it difficult to access.

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SHUTTLE TRANSPORTATION BETWEEN THE RED LINE COMMUTER TRAIN AND RANGSIT UNIVERSITY'S COMMUNITY

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Abstract - Shuttles are important for Mueang Ek residents and commuters commuting across the area due to their accessibility and affordability. Rangsit University is located in Mueang Ek, hence shuttles are the most common mode of transportation for its staff and students. Lak Hok Station is the nearest Red Line train station to Rangsit University; however, it is quite far to walk. Therefore, shuttles are necessary for this route; nevertheless, shuttle services between Lak Hok Station and Rangsit University have not been publicly offered.Rangsit University shuttle services and current shuttle providers are the two suggested shuttle services for this route. Because of its ease of use and lack of substantial drawbacks, the latter is regarded as an excellent method. Lak Hok Station-Rangsit University shuttle services are estimated to cost 5 baht per ride for pick-up truck taxis and 15 baht per ride for motorbike taxis. Contributions from Rangsit University's sponsors, incorporating this cost into tuition fees, and students paying on their own are the three shuttle service payment options for Rangsit University employees and students. The last approach is the most practical because, prior to the arrival of the Red Line trains, students had to pay for their own transportation expenses. Qualitative and quantitative research may be developed in the future to provide more explanations and explicit findings.

Keywords - Electrified Trains, Mass Transit System, Metro Trains, Red Line Commuter Trains, Shuttle Transportation

I. INTRODUCTION

Since traffic congestion has been a critical problem in many areas of Bangkok and its vicinity, particularly during rush hours, the Thai government has prioritized investment in several basic infrastructure projects as one of the key strategic plans for communication system development, particularly investing in mass transit networks. This may not only help to ease traffic congestion, but it may also help to conserve energy and reduce imported oil expenses. The 11-Year Transportation Utility Development Strategic Plan (2015-2025) was authorized on October 21, 2014, with a budget of 2 trillion baht, divided into two phases: 1) the 2015 urgent period of 68,977 million baht; and 2) the 10-year period (2016-2025) of 1.938 trillion baht. These projects were supposed to infuse money into the economy by focusing on the construction of a mass transportation network to alleviate traffic problems in Bangkok and its surrounding areas (Bangkok Metro, 2014).Since this development may efficiently and sustainably relieve congestion in the traffic Bangkok Metropolitan Region, mass transit networks or rail transit services have been widely accepted as the most effective means of public transportation for those living in Bangkok and surrounding areas. A metro train service may carry up to a thousand passengers every journey; therefore, it is ecologically beneficial since it saves energy, minimizes the use of private vehicles, and lowers carbon emissions (State Railway of Thailand, 2015). Currently, the Bangkok Metropolitan Region has three major metro train systems: 1) the Bangkok Mass Transit System, often known as the BTS or Skytrain; 2) the Metropolitan Rapid Transit System (MRT), which includes the Blue Line and Purple Line; and 3) the Airport Rail

Link (Bangkok Mass Transit System, 2018; Bangkok Metro, 2014; Mass Rapid Transit Authority of Thailand, 2016). However, due to a limited number of train lines and inadequate connections between those services, buses continue to account for 75 percent of the use of public transport among Bangkok Metropolitan Region commuters (Verdict Media, 2021).

The State Railway of Thailand has undertaken the Commuter Train System (Red Line) Project to provide train services between Bangkok's downtowns and suburban districts. The mass rapid transit network of this project comprises of three routes: the Dark Red Line (Thammasat University Rangsit Campus-Maha Chai), the Light Red Line (Salaya-Hua Mak), and the Airport Rail Link (Don Mueang-Suvarnabhumi) (State Railway of Thailand, 2018). The Bang Sue-Rangsit Section of thisproject is part of the Mass Rapid Transit Master Plan in Bangkok Region (M-MAP), which Metropolitan was authorized by the Cabinet on May 22, 2007, with a budget of 59,888 million baht. The construction began on February 10, 2013, and was scheduled to be finished in four years. This initiative has four major aims. First, it aims to minimize traffic congestion at eight junctions where trains intersect roads and to achieve a zero-accident rate. Second, it is intended to improve the capacity of the railways in the north and northeast suburbs. Third, it intends to increase the capacity of commuter train lines in order to minimize fuel consumption and improve environmental quality. Fourth, it helps to increase the number of people who use the railway system. Each day, the route from Rangsit to Bang Sue is projected to carry more than 306,608 passengers. Furthermore, when the route is expanded to Ban Phachi Junction, it is anticipated to serve 449,080 passengers per day (State Railway of Thailand, 2018). The Bang Sue-Rangsit section starts from the Pradiphat T-junction, which is located 1.8 kilometers south of Bang Sue station. The route follows the northern railway through Chatuchak, Bang Khen, Lak Si, and Don Muang before arriving at Rangsit Station in Prathum Thani Province. The route will be expanded to include Thammasat University Rangsit Campus in the future (Verdict Media, 2021). Out of a total length of 26.3 km, 19.2 km will be raised from Bang Sue to Don Muang, while the remaining 7.1 km from Don Muang Station to Rangsit will be at-grade and fence-lined. The latter will be linked to the current northern railway and will contain standard-gauge rail track (State Railway of Thailand, 2018).

In August 2021, the Red Line Commuter Train System began operations with two sections, the Bang Sue-Rangsit Section and the Bang Sue-Taling Chan Section (MGR Online, 2021). The Bang Sue-Rangsit route is 26 kilometers long and takes 25 minutes to travel, whereas the Bang Sue-Taling Chan route is 15 kilometers long and takes 15 minutes to travel. Bang Sue-Rangsit line has ten stops, including Bang Sue Grand Station, Chatuchak Station, Wat Samian Nari Station, Bang Khen Station, Thung Song Hong Station, Lak Si Station, Kan Kheha Station, Don Mueang Station, Lak Hok Station, and Rangsit Station, whereas Bang Sue-Taling Chan line has three stops, Bang Son Station, Bang Bamru Station, and Taling Chan Station. Commuter trains on the Red Line arrive every 30 minutes at all stations and every 15 minutes during rush hour, allowing for 78 trips per day on each route. Every day, the Bang Sue-Rangsit section can serve 1,710 passengers every ride, while the Bang Sue-Taling Chan section can serve 1,120 passengers per ride (Prachachat, 2021).

Lak Hok Station, one of the stops on the Bang Sue-Rangsit Line, is the nearest train station to Rangsit University. However, according to Google Maps, a navigation app produced by Google (2021), it is approximately 2.4 kilometers from Rangsit University, which might take up to 30 minutes to walk. Currently, there is no proactive shuttle service between Lak Hok Station and Rangsit University, as well as the communities around Rangsit University. This could be because the station and the Red Line commuter train services have only been in operation for less than a week, and there are only a few passengers as a result of the Covid-19 lockdown's consequences, such as school closures, a limited number of passengers per ride, and people staying at home.Hence, the purpose of this article is to examine he existing public transportation between Lak Hok Station and Rangsit University and the surrounding communities prior to the arrival of the Red Line trains, to suggest appropriate and feasible shuttle transportation between Lak Hok Station and Rangsit University and the surrounding communities, and to explore suitable payment methods and fees for such shuttle transportation.

Accessible Public Transportation for Rangsit University and Surrounding Communities, Prior to the Advent of the Red Line Commuter Trains Rangsit University is located in Mueang Ek, a large community in Thailand's Pathum Thani region. Buses and minibuses are the most common modes of public transportation for residents of Mueang Ek, as well as Rangsit University staff and students. Table 1 lists the specifics of these accessible buses and minibuses. These buses have a stop just in front of Phahon Yothin 87 Alley. Other than personal transportation, individuals that travel through this alley and nearby areas use shuttle services, including pick-up truck taxis and motorbike taxis.

Bus/minibus number	ibus er Route			
	Buses			
29	Hua lamphong - Rangsit			
29 AC	Hua lamphong - Rangsit			
34	Rangsit - Hua lamphong			
20	Kasetsart University - Future			
39	Park Rangsit			
39 AC	Victory Monument - Talat Thai			
59	Sanam Luang - Rangsit			
59 AC	Sanam Luang - Rangsit			
95a	Bang Kapi - Rangsit Garage			
185	Klongtoey - Rangsit			
503	Sanamluang - Rangsit			
504	Krungthep bridge - Rangsit			
510 Victory Monument - Thamma				
520 Minburi - Talat Thai				
522	Victory Monument - Rangsit			
520	Thammasat University Rangsit			
529	Campus - Hua lamphong			
	Priest Hospital Bus -			
538	Rajamangala University Of			
	Technology Thanyaburi			
554 AC	Suvarnabhumi - Rangsit			
555	Suvarnabhumi (Public			
555	Transportation Center) - Rangsit			
	Minibuses			
39	Min Buri -Future Park Rangsit			
83	Victory Monument -Future Park			
	Rangsit			
0.4	Victory Monument -			
84	Rajamangala University Of			
	Technology Thanyaburi			
85	Victory Monument - Thammasat			
	Damlehoush con a Llaineauit			
94	Ramkhamhaeng University -			
	Kangsu			

Table 1. Public transports to Mueang Ek and Rangsit University stopping at Phahon Yothin 87 Alley Note.Adapted from Google Maps: Mueang Ek, 2021. Copyright 2021 by Google; Direction to Rangsit University, 2010. Copyright 2010 by Rangsit University.

Shuttle Transportation Options between Lak Hok Station and Rangsit University, as well as the Surrounding Communities Shuttle services are not new to residents of Mueang Ek or commuters that travel to this region. People can travel around Mueang Ek by shuttle pick-up truck taxis and motorbike taxis, despite the fact that they do not travel in private vehicles. Because Mueang Ek is a large neighborhood, it is home to a variety of businesses and landmarks, including Lak Hok Station and Rangsit University. Buses and minibuses are the most common modes of public transportation used to travel to Mueang Ek; however, with the introduction of Red Line commuter train services in August 2021, this transportation mode is regarded as one of the best alternatives for Mueang Ek commuters. For passengers traveling to Mueang Ek, the nearest Red Line railway stop is Lak Hok. It is situated at the junction of Phahon Yothin 87 Alley and Ek Thaksin Road, or between the entrance of Phahon Yothin 87 Alley and the entrance of Rangsit University that close to Ek Thaksin Road. The station is about 1.5 kilometers from the entrance of Phahon Yothin 87 Alley and 2.4 kilometers from Rangsit University (Google, 2021). Hence, Red Line commuter train passengers who intend to visit Rangsit University and the neighboring districts must rely on shuttle services because the distance is too far to walk. However, as the Red Line train services have only been in operation for less than a month, the shuttle services along this route have not been adequately supplied. Furthermore, owing to the Thai government's enforced lockdown to prevent the spread of Covid-19, the number of passengers traveling along this route is low; therefore, the shuttle services may not attract providers since they cannot earn a lot of money. Nonetheless, if schools and universities reopen and businesses can run regularly, the shuttle transportation along this route will be important for commuters in the future, as there will be numerous commuters commuting to Mueang Ek, as well as students going to Rangsit University and schools in this area. To increase the convenience of Red Line train passengers, the following two options for shuttle services between Lak Hok Station and Rangsit University and adjacent villages are proposed.

1. Rangsit University may runsshuttle services for its staff and students.

According to the internal education quality assurance report for higher education for the academic year 2012, Rangsit University (2012), the number of students registered at Rangsit University is 28,134, with 1,335 teachers, and there are an additional 704 university staff. This indicates that if Rangsit University is operating as usual, about 30,000 individuals will travel there every working day.Therefore,running shuttle services between Lak Hok Station and Rangsit University by Rangsit University itself to accommodate the university's staff and students might be taken into account.

Shuttle services are provided by several educational institutions for their students and employees. For example, the Chulalongkorn University CU Shuttle Bus, often known as the Chula Pop Bus, is a shuttle service that runs not only within Chulalongkorn University but also to surrounding districts such as Siam Square and National Stadium. The shuttle buses run on five lines, with departures every five to ten minutes. They connect with mobile phones through the CUPopbus app. Chula Pop Bus also serves Chulalongkorn University's employees and students, as well as other commuters who like to go near the university (Chulalongkorn University, n.d.). The NGV bus is a shuttle service provided by Thammasat University, Rangsit Campus. These shuttle buses are open-air buses that run on NGV to reduce carbon emissions. The services make it easier for commuters to get around campus, and the timetables for the services may be found on the ThammaTrans app. This application can also follow a user's bus and alert them when it arrives at its destination (Thammasat University, 2018).

Hence, Rangsit University may have the potential to provide such services for its staff and students, as well as other commuters who intend to travel around the campus and neighboring areas. However, there are certain critical factors that must be addressed. The first concern is financing for such investments. To develop shuttle services, a large amount of money is required to purchase or rent the vehicles as well as to operate the services, such as maintenance expenses, fuel costs, and personnel costs. The university needs to weigh whether the shuttle services are worthwhile for the investment or not. The second concern is disputes between the institution and the existing shuttle providers. If Rangsit University runs the shuttles, it may have an impact on the current local shuttle service providers. Rangsit University shuttle services will share the market with existing providers, reducing their earnings; as a result, conflicts between these parties may arise.

2. The current shuttle services running along Phahon Yothin 87 Alley and nearby areas might share services with Lak Hok Station Stop to accommodate all commuters.

This might be the simplest and quickest solution to provide shuttles for Red Line commuter train passengers and commuters who want to go around Mueang Ek. Using the current shuttle services that normally operate along Phahon Yothin 87 Alley and adjacent locations saves the government sector and Rangsit University time and money because no new investments are required and the providers just slightly alter the routes of shuttle services. Furthermore, this method will avoid conflicts between Rangsit University and local suppliers. Lak Hok Station is located between the Phahon Yothin 87 Alley entrance and Rangsit University. Currently, the shuttle hub is located near the entrance of Phahon Yothin 87 Alley, so the providers may establish a new hub at Lak Hok Station to make it easier for passengers.

Payment Methods and Fees for Shuttle Transportation from Lak Hok Station to Rangsit University, as well as Nearby Communities for Rangsit University Students

Currently, the shuttle services from Phahon Yothin 87 Alley to Rangsit University cost 8 baht per ride for pick-up truck taxis and 25 baht per ride for motorbike taxis. For those who prefer to take taxis, the service expenses for this trip are about 50 baht. According to Google (2021), the distance between Phahon Yothin 87 Alley entrance and Rangsit University is around 3.6 kilometers, whereas Rangsit University is roughly 2.4 kilometers from Lak Hok Station. As a result, based on distance, the new shuttle services from Lak Hok Station to Rangsit University must be cheaper than the current services. Pick-up truck taxis may charge approximately 5 baht per journey, whereas motorbike taxis may charge around 15 baht per journey. Rangsit University has explored payment methods for the shuttle services on the Lak Hok Station-Rangsit University route because they are new. This article proposes three possible approaches, which are as follows:

a. Rangsit University's sponsors contribute to shuttle transportation expenses.

Shuttle services provided by public universities in Thailand, such as Chulalongkorn University and Thammasat University, are typically free because the government funds these educational institutions' annual budgets. However, because Rangsit University is a private university, the finances are mostly derived from tuition fees, and many businesses often sponsor academic and student activities. The cost of shuttle service is undeniably enormous, and Rangsit University cannot cover them on its own. Based on the estimated fees in the previous paragraph, if half of the Rangsit University population, or approximately 15,000 people (Rangsit University, 2012), use return shuttle services, it will cost around 150,000 baht per day for pick-up truck taxis and around 450,000 baht per day for motorbike taxis. Thus, it is doubtful if these costs can be covered by sponsors. Because these costs are somewhat high, the best possible scenario is that the sponsors can support these costs for a short period of time, such as a few months after the launch of Red Line train services, to increase the use of Red Line trains; however, this method is less likely to be implemented in the long run because it does not provide profits to the companies.

b. The cost of shuttle transportation is included in the tuition fees.

This approach may be the best possible way to provide convenience for Rangsit University staff and students who plan to use shuttles. However, there are certain difficulties that must be addressed. First, imposing a shuttle service price on all students may be unfair to those who do not use shuttles. Second, if the shuttle service fee is an additional charge for some students who intend to use the shuttle throughout the semester, students who may sometimes use shuttle services will he excluded. Third, because the shuttle transportation fee is included in the tuition fees, other university personnel using the services without paying is unjust to the students who pay for these services. Hence, approach necessitates additional using this discussions.

c. Students are responsible for their own shuttle transportation costs.

This approach could be the best practice for the university and its students. Long before the advent of Red Line train services, Rangsit University students had to pay for their own transportation. As a result, when the Red Line trains go to Mueang Ek, it provides an alternate mode of transportation for those students who can handle the fees on their own.

II. CONCLUSION

Shuttles are an important mode of transportation for residents of Mueang Ek and commuters traveling throughout the surrounding region because they are accessible and inexpensive. Rangsit University is located in Mueang Ek, therefore shuttles are the most popular mode of transportation for its employees and students. The Red Line commuter train service started in August 2021, and it passes through Mueang Ek, which is the location of Lak Hok Station. However, there have been no effective shuttle services between Lak Hok Station and Rangsit University, as well as the communities surrounding Rangsit University, and this could be due to a low number of passengers on the Red Line train services, which were impacted by the Covid-19 lockdown and the train services' new operation. Hence, this article addresses the existing public transportation between Lak Hok Station and Rangsit University and the surrounding communities prior to the arrival of the Red Line trains, as well as the appropriate shuttles for this route, and suitable payment methods and fees for such shuttle transportation.

Prior to the advent of the Red Line commuter trains, buses and minibuses were the most common public

transportation for people living in Mueang Ek, as well as Rangsit University staff and students. These buses have a stop just in front of Phahon Yothin 87 Regardless of personal transportation, Alley. individuals that travel through this alley and nearby areas use shuttle services, which are pick-up truck taxis and motorbike taxis. When the Red Line trains operate to Mueang Ek, the shuttles require Red Line train passengers who do not use private vehicles, as well as people who travel around this area. Hence, two shuttle services are suggested to provide ease of travel for commuters. The first one is Rangsit University running shuttle services for its staff and students, and probably for external commuters: however, this may require a lot of money and create conflicts between the university and existing local shuttle providers. Another one is the current shuttle services sharing services with Lak Hok Station Stop to accommodate all commuters. If this method is applied, Rangsit University does not need to invest in the services and can avoid arguments. It is suggested that a new shuttle hub should be established at Lak Hok Station to make it easier for passengers. Having considered the fees of Lak Hok Station-Rangsit University shuttle services, based on the current shuttle fees between Phahon Yothin 87 Alley entrance and Rangsit University, pick-up truck taxis may charge around 5 baht per ride and motorbike taxis may charge around 15 baht per ride. Moreover, the three payment methods for the shuttle services on the Lak Hok Station-Rangsit University route for Rangsit University staff and students include Rangsit University's sponsors contributing to shuttle transportation expenses, including this expense in the tuition fees, and students paying for their own shuttle transportation costs. The two former methods need further debates as there are some concerns about the application; however, the last one is the most practical because it is the common method for Rangsit University students that has been conducted before the introduction of the Red Line trains.

Hence, the ideal approach for shuttle services from Lak Hok Station to Rangsit University so far is to employ the current shuttle providers since they can be used promptly without any concerns. Furthermore, students paying their own shuttle fees is the easiest alternative because they used to pay such costs prior to the advent of the Red Line railway. Qualitative and quantitative research may be conducted in the future to provide additional explanations and unambiguous findings.

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USING RFM MODEL FOR CUSTOMER SEGMENTATION AND CLV

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Abstract - Ecommerce companies in China are facing a limited amount of customer demographical information provided by eCommerce platforms, which leads to insufficient data for customer segmentation. This research proposed a solution for eCommerce companies to segment their existing clients. From historical transactions, RFM model provides three-criteria analysis results of individual customers. Using the results of RFM analysis and K-means clustering, customer segmentation clusters can be obtained. Then, the fuzzy AHP method provides evaluations of weightings of the three criteria in RFM model, and calculations cluster CLV provides valuable cluster information based on each company's related situations. The case company provides historical transactions from 2017 to 2018, with 2776 customers' information included. The proposed approach identifies four clusters, and each cluster differs significantly from each other in terms of RFM scores. Then, calculations of fuzzy AHP on RFM criterion conclude that monetary is the most essential and vital for the case company criterion, followed by recency and frequency. Cluster CLV results indicate that customers from the most valuable cluster (cluster number 3) are more likely to purchase multiple product lines and categories.

Keywords - RFM, K-means clustering, fuzzy AHP, customer segmentation, eCommerce, eCommerce platform, CLV.

I. INTRODUCTION

Commercial companies that are eager to succeed in drastic competition pay attention to maintain customer relationships by increasing their loyalty through Customer Relationship Management (CRM). CRM is the marketing strategy measures implemented to enhance consumer loyalty and attract new clients (Cheng & Chen, 2009). There are several concepts related to CRM, such as RFM Model, Customer segmentation, and Customer Lifetime Value (CLV). CLV is a marketing concept within CRM domain. It enables companies to use resources objectively based on how much profit clients can generate because CLV determines the value to a company brought by customers within their lifecycle (Kumar, 2008; Greenberg, 2002; Tukel& Dixit, 2013). Compute CLV for each consumer can be timeconsuming and ineffective due to the massive amount of customer transaction data. To be more efficient, CLV can be applied to different customer segments instead of individuals (Haenlein et al., 2007). CLV is calculated appropriately, companies segment clients by on CLV rankings and apply different marketing plans (Hiziroglu&Sengul, 2012).

1.1. Research Problem

For eCommerce companies in China, with the emerging number of transactions and intense competition, specific marketing strategies such as CRM needs to be implemented to maintain existing customer as well as acquiring new consumers in order to succeed. However, since purchasing transactions on most of the eCommerce platform in China do not contain detailed demographic information, it can be hard to obtain valuable data from these transactions. Limited amount of useful information can be obtained from historical transactions, making customer segmentation hard to perform for these companies. Without suitable customer segmentation, relevant customer retention strategies can be problematic and unreliable as well.

1.2. Research Question

One way to solve this problem is by implementing RFM Model as customer segmentation criteria. RFM Model is considered as a common way to measure profitability of customers and evaluate CLV (Hu & Yeh, 2014). RFM Model introduces three variables based on historical data that are recency, frequency, and monetary (Goodman, 1992). Companies can also apply the RFM model due to their business nature by assigning various scoring methods.

1.3. Research Objectives

With RFM Model, customer segmentation criteria are based on Recency, Monetary and Frequency and other information that are provided by eCommerce platforms. RFM Model offset the inferior customer segmentation problem due to limited information. In this research, the goal is to design a CRM process by segmenting consumers base on RFM Model, then estimating CLV using these segments created by RFM Model.

II. DETAILS EXPERIMENTAL

2.1. Research Model

This study attempts to explore a method of customer segmentation, supported by the RFM model and Kmeans clustering. From customer segmentation, results of clusters conclude cluster profiles by analysing transaction information, then calculating CLV based on each cluster to rank the importance of different clusters. The illustration of this model is shown in figure 1.



Fig.1. Proposed model of this research

In this case study, all data are collected from an individual designer fine jewelry company in China with an average customer transaction of 2379.43 CNY (around 340\$) and repurchase rate of 15.92% in and 2018. eCommerce is the leading 2017 distribution channel of this company, and most of the transactions are operated on one of the biggest Chinese eCommerce platforms:Tmall. Data on historical transactions within a two-year time frame are collected. These data include transaction ID, customer ID, transaction time, and payment amount, along with consumers' individual information such as shipping address, personal phone number, and other analytical information. Since eCommerce trading happened online, consumer demographical data are either not registered or kept as confidential by the Therefore, eCommerce platform. segmenting consumers based on their demographic criteria and behavioral data will encounter difficulties such as data insufficient and data ambiguity. For eCommerce companies, customer segmentation is also essential for implementing customer retention strategies and maintaining healthy customer relationship.

2.2. Research Hypothesis

Using historical transactions, eCommerce companies can apply the RFM model and use RMF model result to segment customers using K-means clustering. By applying this model, four clusters are expected to be statistically different from each other by the result of RFM model and CLV, using ANOVA to compare different clusters' means. The null hypothesis and alternative hypothesis are expressed by the following equations (Girden, 1992).

$$\begin{cases} H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4; \\ H1: \mu_i \neq \mu_i \text{, for one } i \neq j \end{cases}$$

2.3. Research Approach

The research approach section presents an approach with three steps that segment customers based on historical transactions. This approach assists eCommerce companies in utilizing limited transaction data downloaded from the eCommerce platform and transforms them into useful information about customer segmentation and CLV. Figure 2 expressed the approach input, process, output diagram that is composed of four parts.



Fig.2. IPO of proposed approach

Step 1: Preparing data

Purchasing transactions downloaded from eCommerce platforms need to be cleaned and replenished with additional information such as product information (e.g., product line, product type and category, and many others). Unsuccessful transactions should be deleted, and transactions with ambiguity should add additional information to be valid.

Step 2: Input – Data cleaning and RFM analysis

Some unanalytical information listed in transactions need to be cleaned (e.g., customer cell phone number and other sensitive customer information). Based on customer shipping addresses, cities that customers lived in are categorized into five different groups based on the development of that city in China. City category 1 means the city is well developed, while 5 means the city is not considered as developed as others.

For the RFM model, SPSS takes transaction data and scales existing clients by recency, frequency, and monetary criteria, respectively. RFM recency analysis on SPSS sort consumers and assigned 1-5 scores for each criterion accordingly (with 5 the most recent, the most frequent and the most profitable in terms of monetary and 1 the least of each criterion). Due to limited research on luxury products RFM analysis weighting, in this approach, each criterion of RFM model is assigned by equal weights.

Step 3: Process – segmentation using K-means clustering

Recency scores, frequency scores, and monetary scores are used to proceed SPSS K-means clustering and identify customer segmentation. In this case, we identified 4 clusters for the case company. These clusters are then used to perform analysis and CLV calculations to find out the most valuable and loyal cluster.

Step 4: Calculation of fuzzy weights RFM model – Fuzzy AHP

The main idea of fuzzy AHP is to design hierarchical structures. In this case, hierarchical structures are related to RFM model. Therefore, the main goal will be RFM, and recency, frequency, and monetary are listed below as criteria.

The sample questionnaire needs to be sent to the experts from the case company to demonstrate the comparative importance of recency, frequency, and monetary insight. The questionnaire contains 3 questions:

- 1. How important is recency in related to frequency
- 2. How important is monetary in related to frequency
- 3. How important is monetary in related to frequency

Choices of the questionnaires' answers are the same with fuzzy linguistic variables (equal, moderately important, very important, strongly important, and extremely important).

Experts' opinions are then accumulated using triangle fuzzy numbers by averaging these fuzzy numbers. Knowing that using linguistic variables results in having triangle fuzzy numbers lie in interval $[\frac{1}{9}, 9]$, these fuzzy numbers need to be transformed to range [0,1] using the equation below (Safari et al., 2016).

$$p_{ij} = \frac{1}{2}(1 + \log_9 aij)$$

If elements of matrix calculated using the previous function larger than [0,1], elements need to be transformed again using transformational functions (Safari et al., 2016).

$$f(x^{L}) = \frac{x^{L} + c}{1 + 2c}$$

$$f(x^{M}) = \frac{x^{M} + c}{1 + 2c}$$

$$f(x^{R}) = \frac{x^{R} + c}{1 + 2c}$$

Finally, other calculations defined by researchers are implemented to calculate crisp weights of the three criteria in AHP (Wang & Chen, 2008).

(1) Calculate the mean comparison for rows:

$$\widetilde{g_i} = \frac{1}{n} [\widetilde{p_{i1}} \oplus \widetilde{p_{i2}} \oplus \dots \oplus \widetilde{p_{in}}], i = 1, 2, \dots n$$

(2) Calculate criteria weights:

$$\widetilde{w_i} = \frac{g_i}{\widetilde{g_1} \bigoplus \dots \widetilde{g_n}}$$
(3) Calculate crisp weight values:

$$W_i = \frac{w_i^L + w_i^M + w_i^R}{3}$$

Step 5: Output – CLV calculation of clusters based on RFM

Using K-means clustering algorithm, cluster centers can be identified. In previous research, ways to calculate CLV for each cluster is identified by researchers. Firstly, cluster results need to be normalized using normalized functions (Safari et al., 2016):

$$N_{v} = \frac{v - \min}{\max - \min} (new_{max} - new_{min}) + new_{min}$$
$$N_{v} = \frac{v - \min}{\max - v} (new_{max} - new_{min}) + new_{min}$$

Then, CLV function defined by Khajvand et al. in 2011 is used to calculate CLV for each cluster combined with weights calculated using fuzzy AHP.

$$CLV_{ci} = NR_{ci} \times W_R + NF_{ci} \times W_F + NM_{ci} \times W_M$$

2.4. Sampling

In this research, block sampling of historical transactions of 2017 and 2018. Because the case company holds a relatively high average customer transaction amount and relatively low repurchasing rate, using the historical transaction of 2018 solely results in biased analysis and ignore returned consumers. In total, there are 2776 customers and 3454 transactions.

2.5. Data Analysis

In this research, the validation process of this model will be the analysis of variance (Levene's test and ANOVA) and Scheffe's F, because of dependent variables (recency, frequency, and monetary degrees) are numerical. In contrast, independent variables are final produced clusters (Chernick&Friis, 2003). The hypothesis of variance analysis is whether different groups have equal variances. Results derived from ANOVA is used to compare means between clusters (Safari et al., 2016).

III. RESULTS AND DISCUSSION

3.1. RFM model

In table 1, an example of RFM analysis steps is demonstrated. From historical transactions, recency, frequency, and monetary are calculated. RFM on SPSS is very simple. SPSS splits customers into five equal group, with the top 20% of the three factors a score of 5, the next 20% a score of 4, and so on. Using RFM model, there are 125 unequal groups of customers at most ($5 \times 5 \times 5$). In this case, equalweighted RFM are used. Therefore, the most valuable customers scored 555, while the least valuable customers scored 111.

RFM model provides a method to quantify past customer behavior. For instance, the customer with ID number 1 has two as a recency score, 5 as a frequency score and 3 as a monetary score. Customer 1, therefore, has an RFM score of 253. From RFM score, one can say that customer 1 is not a recent buyer or willing to pay a lot but buys them frequently.

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ID	Recen-cy	Transacti-on	Amo-unt	R Scorp	F Sco. ro	M Sco. ro	RFM
	(uays)	(count)		300-16	500-10	500-10	500-16
1	365	2	2160.0	2	5	3	253
2	339	2	2375.4	3	4	3	343
3	367	1	2630.0	2	2	5	225
4	367	2	3498.0	2	5	5	255
5	367	1	930.00	2	2	3	223
6	367	2	2220.0	2	5	3	253
7	367	1	2260.0	2	2	5	225
8	367	2	1799.0	2	5	1	251
9	368	1	930.0	2	2	3	223
10	368	1	960.0	2	2	3	223

Table 1. RFM analysis on SPSS

In this case study, the customer retention rate is low, and the average transaction amount is considerably high. Therefore, frequency scores have only 3 groups (2, 4, and 5) instead of 5 groups (1, 2, 3, 4, and 5). To view the RFM model more intuitively, figure 3 shows RFM distribution of this case company with numbers of customers for each group. Some RFM values, such as 141, are not assigned to any customer. While figure 4 displays a scatter plot of the RFM analysis.







Fig.4. 3D scatter plots of RFM model

3..2. K-means clustering and customer segmentation

K-means clustering is a popular method of segmenting customers. In this case, customers are segmented based on RFM scores by using K-means clustering on SPSS. Customers were segmented into four groups, with cluster 2 holding the most of customers (1762, 63.47%) and cluster 3 holding the least of customers (249, 8.97%).

Clust	Number of	Percentage of total					
er	customers	customers					
1	340	12.25%					
2	1762	63.47%					
3	249	8.97%					
4	425	15.31%					
Total	2776	100.00%					
,	Table 2: Clusters and number of customers						

From the K-means clustering analysis, several descriptive analyses of categorical data can be performed as well. From the information of historical transactions, several categorical data can be derived, such as city categories from shipping address. Other categorical data are based on transaction details, such as whether the customer bought several times, multiple products, multiple product lines, and multiple product categories. These categorical data can help with identifying possible customers for promotion.

From the shipping address registered by customers, the cities' customers belong to can be sorted out. According to city categories definition in China, there are five tiers of cities. Examples of first category cities are cities that are very developed such as Beijing, Shanghai, Guangzhou, and some other cities. These first-tier cities were noted as 1. Second category cities are less matured than cities in the first tier and were noted as 2. Least developed cities are fifth-tier cities and were noted by 5. City categories can tell how developed a city is. By developed, it means that the city is economically wealthy, with more population, more job opportunities, better education system, and better medical system. Customers from these developed cities are more likely to consume more due to higher disposable income. Therefore, clusters having more customers from developed cities are potential customers for pitching during promotions. Figure 5 and Table 3 illustrate clusters and customer numbers from each city tiers.



Cluster	1 st Tier City	2 nd Tier City	3 rd TierCity	4 th Tier City	5 th Tier City	Total		
1	113	80	56	44	47	340		
1	(33.2%)	(23.5%)	(16.5%)	(12.9%)	(13.8%)	(100%)		
2	697	420	293	189	163	1762		
	(39.6%)	(23.8%)	(16.6%)	(10.7%)	(9.3%)	(100%)		
2	126	51	39	13	20	249		
3	(50.6%)	(20.5%)	(15.7%)	(5.2%)	(8.0%)	(100%)		
4	166	113	63	42	41	425		
	(39.1%)	(26.6%)	(14.8%)	(9.9%)	(9.7%)	(100%)		
Total	1102	664	451	288	271	2776		
	(39.7%)	(23.9%)	(16.3%)	(10.4%)	(9.8%)	(100%)		

Table 3: Clusters and city category

Another important indicator of business is the customer retention rate within a period. From historical transactions, new customers or old customers can be identified directly. Based on historical transactions, customers that purchased several times were categorized by "Multiple Transactions", stating that these customers purchased several times within a specified period. New customers are the ones that purchased only once within this period and were categorized by "New Customer". In this case, new and old customers in

each cluster are counted to see which cluster has the highest retention rate. Cluster with the highest retention rate is possibly more loyal and are possibly able to transform to brand members. Figure 6 and Table 4 display details clusters and customer retention. Table 4 shows cluster 4 holds the eldest customers, while cluster 3 holds the most percentage of old customers. These old customers from cluster 3 and 4 are more likely to join brand loyalty programs if they are not recorded as members.



Fig.6. Clusters and new or old customers

			8	e			
	Cluster	Multiple	e Transactions	New	Consumer	Total	
_	1	100	29.41%	240	70.59%	340	
	2	0	0.00%	1762	100.00%	1762	
	3	130	52.21%	119	47.79%	249	
	4	212	49.88%	213	50.12%	425	
	Total	442	15.92%	2334	84.08%	2776	

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Table 4: Clusters and customer retention details

Sometimes, customers buy more than one product category. In this case, the case company offers rings, necklaces, bracelets, and many other product categories. Knowing what product categories customers bought implies customers' preferences. Analyzing product categories can help the company to comprehend customer preferences. For example, if a customer bought a single product category several times, recommendations of other products in this category can be made to this customer. If a customer bought several products from different categories, that means it is more open to different products. In figure 7 and table 5, detailed information about clusters and product categories are displayed. In this case, the number of customers who bought several product categories is limited.



Cluster	Multip	le Categories	Sing	Single Category	
1	17	5.00%	323	95.00%	340
2	0	0.00%	1762	100.00%	1762
3	112	44.98%	137	55.02%	249
4	150	35.29%	275	64.71%	425
Total	279	10.05%	2497	89.95%	2776

Fig.7. Clusters and product categories

 Table 5: Clusters and customer product categories preferences

In this case, there are several product lines with different design inspirations. Whether a customer is willing to purchase multiple product lines express their willingness to accept design inspirations. If a cluster contains more consumers that are willing to purchase products from different product lines, that means this cluster, compares to other clusters, is more loyal and is more receptive. Figure 8 and Table 6 show a descriptive analysis of clusters and product lines. Cluster 4 holds the most customers who bought multiple product lines, while cluster 3 holds the most percentage of customers who bought multiple product lines.



Fig.8. Clusters and product lines

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Cluster	Multiple Product Lines		Single	Single Product Line	
1	66	19.41%	274	80.59%	340
2	0	0.00%	1762	100.00%	1762
3	132	53.01%	117	46.99%	249
4	178	41.88%	247	58.12%	425
Total	376	13.54%	2400	86.46%	2776

Table 6: Clusters and customer product lines preferences

ECommerce platforms offer several sales promotion holidays every year, the biggest ones of these sales promotions are June 18th and November 11th. During these sales promotion holidays, companies operating on these eCommerce platforms are required to offer specific discount rates that are lower than the highest discount rate of membership. In this case, the discount rate is calculated by the average discount rate of several transactions (the paid amount / original price of products). Average discount rate lower than 95% is recognized as "Sales Promotion". Customers with "Sales Promotion" noted means that these customers bought during sales promotions only. Average discount rate between 100% and 95% are recognized as "Membership", meaning that customers bought only using their membership discounts. If the average discount rate equals to zero, that means these customers have not attended brand loyalty program or sales promotions, noted as "No Discount".

In figure 9 and table 7, details of descriptive analysis of clusters and discount rates are displayed. Customers attended in membership programs are mostly in cluster 2, but cluster 3 holds the most percentage of membership customers compares to other clusters. The goal of the business is to maximize membership discount and no discount amount of consumers to achieve more profits and increase loyalty. Since sales promotions have alluring discount rates and customers always attempt to capture tempting discount rate, efficient revenue management of sales promotions should be considered to maximize profits.



Cluster	Me	mbership	No	Discount	Sales I	Promotion	Total
1	103	30.29%	98	28.82%	139	40.88%	340
2	366	20.77%	716	40.64%	680	38.59%	1762
3	77	30.92%	61	24.50%	111	44.58%	249
4	87	20.47%	83	19.53%	255	60.00%	425
Total	633	22.80%	958	34.51%	1185	42.69%	2776

Fig.9. Clusters and discount details

Table 7: Clusters and discount details

3.3. CLV calculation for clusters

To calculated CLV for each cluster, the steps listed in research approach are used. Firstly, weights assigned for CLV calculations using fuzzy AHP were calculated using methods listed in research approach step 4. To know companies' experts' opinions toward RFM model, questionnaires were sent to the companies' experts. Five experts expressed their opinions, listed in table 8. Then, the average triangle fuzzy numbers were calculated to obtain "accumulated experts' opinions;" (table 9). From accumulated experts' opinions, the equation of instructing comparison matrix were used to calculated the incomplete fuzzy linguistic preference matrix (table 10). After constructing incomplete fuzzy linguistic preference matrix, other information in the fuzzy linguistic preference relation decision matrix can be filled by adopting reciprocity of experts' related cells (table 11). Noticing that all elements in fuzzy linguistic preference relation decision matrix are in range 0 to 1, no transformation is needed. From fuzzy linguistic preference relation decision matrix, fuzzy weights and crisp weights were calculated (table 12).

	Recency	Frequency	Monetary
Recency	1	VI, E, VI, MI, SI	
Frequency		1	
Monetary	VI, SI, E, VI, SI	SI, VI, EI, VI, VI	1
	Table 8: Experts' opinions in	linguistic assessment variables	
	Recency	Frequency	Monetary
Recency	(1, 1, 1)	(2.6, 4.2, 6.2)	
Frequency		(1, 1, 1)	
Monetary	(3.4, 5, 7)	(4.2, 6.2, 7.8)	(1, 1, 1)
	Table 9: Accumulation	ted experts' opinions	
	Recency	Frequency	Monetary
Recency	(0.5, 0.5, 0.5)	(0.72, 0.83, 0.92)	
Frequency		(0.5, 0.5, 0.5)	
Monetary	(0.78, 0.87, 0.94)	(0.83, 0.92, 0.97)	(0.5, 0.5, 0.5)
	Table 10: Incomplete fuzzy	linguistic preference matrix	
	Recency	Frequency	Monetary
Recency	(0.5, 0.5, 0.5)	(0.72, 0.83, 0.92)	(0.06, 0.13, 0.22)
Frequency	(0.08, 0.17, 0.28)	(0.5, 0.5, 0.5)	(0.03, 0.08, 0.17)
Monetary	(0.78, 0.87, 0.94)	(0.83, 0.92, 0.97)	(0.5, 0.5, 0.5)
	Table 11: Fuzzy linguistic pre	ference relation decision matrix	
	Fuzzy Weig	hts	Crisp Weights
Recency	(0.25, 0.32, 0	0.41)	0.33
Frequency	(0.12, 0.17, 0	0.24)	0.18
Monetary	(0.42, 0.51)	0.6)	0.51

Table 12. Tuzzy weights and erisp weights of RTM erichta

From K-means clustering algorithms, cluster center outputs are obtained. Since factor recency harms CLV (the more recency in days, the less value or profit), cluster centers were normalized using normalization equationsresearch approach step 5. Table 13 displays the output of cluster centers and normalized cluster centers. CLV calculations were then performed to obtain CLV and CLV rankings for each cluster, displayed in table 14.

Clusters	Cluster CenterR	ClusterCenterF	ClusterCenter M	Norma- lized NR	Norma- lized NF	Norma- lized NM
1	406.00	2.00	1997.13	0.00	0.54	0.19
2	289.00	1.00	1020.94	0.46	0.00	0.00
3	404.00	2.84	6270.78	0.01	1.00	1.00
4	151.00	2.00	2242.57	1.00	0.54	0.23
	Tab	ble 13: Cluster centers a	and normalized cluster co	enters		
Clusters	$NR \times W_R$	$NF \times W_F$	$NM \times W_M$	CLV	CVL	Ranking
1	0.00	0.10	0.09	0.19		3
2	0.15	0.00	0.00	0.15		4
3	0.00	0.18	0.51	0.69		1
4	0.33	0.10	0.12	0.54		2

Table 14: CLV and rankings of clusters

3.4. Results of the hypothesis test

Validations of hypothesis consist of 2 parts: customer segmentation validation and CLV calculation validation. Both validations use analysis of variance (ANOVA) and Scheffe's F value to analyze variance differences between clusters. According to Girden in 1992, ANOVA compares means between clusters, with null hypothesis stating all means in different clusters are the same, while alternative hypothesis stating at least one cluster has different means from other clusters. Analysis of customer segmentation variance tests were run on SPSS. The results of ANOVA tests and Scheffe's F as multiple comparison techniques tell which pairs of means are different. Results of running ANOVA are displayed in table 15. With a significance level less than 5%, rejection of the null hypothesis (all customer segmentation cluster means are the same) and acceptance of alternative hypothesis (at least one segment cluster's mean is different from other clusters' means). Also, from Scheffe's multiple comparison results, all cluster means of one segment are significantly different from other segments, stated in table 16.

ANOVA – Customer segmentation based on RFM scores		Sum of Squares	df	Mean Square	F	Sig.
Decenary	Betwe-en Groups	1323.080	3	441.027	289.224	.000
_score	Within Groups	4226.920	2772	1.525		
	Total	5550.000	2775			
Fraguancy	Betwe-en Groups	4140.771	3	1380.257	19261.805	.000
_score	Within Groups	198.635	2772	.072		
	Total	4339.406	2775			
Monotomi	Betwe-en Groups	1022.272	3	340.757	218.515	.000
_score	Within Groups	4322.719	2772	1.559		
	Total	5344.991	2775			
Table 15: ANOVA results of customer segmentation based on RFM scores						

							95%	
Dopondont V	Jariabla		Mean Difference	Std Emer	Sig	Confidence	ce Interval	
Dependent Variable			(I-J)	Stu. LITOI	Sig.	Lower	Upper	
						bound	Bound	
		2	-1.006^{*}	.073	.000	-1.21	80	
	1	3	561*	.103	.000	85	27	
		4	-2.494*	.090	.000	-2.75	-2.24	
		1	1.006^{*}	.073	.000	.80	1.21	
	2	3	.445*	.084	.000	.21	.68	
Recency		4	-1.488^{*}	.067	.000	-1.67	-1.30	
score		1	.561*	.103	.000	.27	.85	
	3	2	445*	.084	.000	68	21	
		4	-1.934*	.099	.000	-2.21	-1.66	
		1	2.494^{*}	.090	.000	2.24	2.75	
	4	2	1.488^{*}	.067	.000	1.30	1.67	
		3	1.934^{*}	.099	.000	1.66	2.21	
		2	2.794^{*}	.016	.000	2.75	2.84	
	1	3	$.212^{*}$.022	.000	.15	.27	
		4	.531*	.019	.000	.48	.59	
		1	-2.794^{*}	.016	.000	-2.84	-2.75	
	2	3	-2.582^{*}	.018	.000	-2.63	-2.53	
Frequency		4	-2.264*	.014	.000	-2.30	-2.22	
score		1	212*	.022	.000	27	15	
	3	2	2.582^*	.018	.000	2.53	2.63	
		4	.319*	.021	.000	.26	.38	
		1	531 [*]	.019	.000	59	48	
	4	2	2.264^{*}	.014	.000	2.22	2.30	
		3	319*	.021	.000	38	26	
		2	-1.012*	.074	.000	-1.22	80	
Monetary	1	3	-2.632*	.104	.000	-2.92	-2.34	
score		4	788 [*]	.091	.000	-1.04	53	
	2	1	1.012^{*}	.074	.000	.80	1.22	

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Configure in the Castonic Segmentation and CD v							
	3	-1.620*	.085	.000	-1.86	-1.38	
	4	$.224^{*}$.067	.012	.04	.41	
	1	2.632^{*}	.104	.000	2.34	2.92	
3	2	1.620^{*}	.085	.000	1.38	1.86	
	4	1.844^*	.100	.000	1.57	2.12	
	1	$.788^{*}$.091	.000	.53	1.04	
4	2	224*	.067	.012	41	04	
	3	-1.844^{*}	.100	.000	-2.12	-1.57	

Using RFM Model for Customer Segmentation and CLV

Table 16: Scheffe multiple comparisons of customer segmentation based on RFM scores

The second part of the research result validation is the validation of the clusters' CLV calculations, ANOVA, and Scheffe method results are displayed in table 17 and table 18. The null hypothesis can be rejected from the significant results of ANOVA (all cluster means are the same), and alternative hypotheses are accepted (at least one cluster mean is different from other clusters' means). Results of the Scheffe's test also conclude that clusters means are different from each other.

ANOVA – CLV	Cluster /	Sum of Squares	df	df Mean Square F		Sig.	
Between (Groups	84.564	3	3 28.188 1.64E+30		0.000	
Within G	roups	.000	2772	.000			
Tota	ıl	84.564	2775				
		Tab	le 17: ANOVA	results of cluster CL	V		
Cluster	N		Subset for $alpha = 0.05$				
Cluster	IN	1		2	3	4	
3	249	0.1512238677					
4	425		0.191	10886562			
2	1762				0.5445343662		
1	340					0.6898613153	
Sig.		1.000	1	1.000	1.000	1.000	
		Table	e 18: Scheffe te	st result of cluster CI	LV		

IV. CONCLUSIONS

Since the satisfaction level of current consumers plays a significant role in business success, companies nowadays are focusing on differentiating by identifying and preserving the most valuable and loyal consumers. This research intends to propose a five-step approach for eCommerce companies to segment existing clients. Firstly, companies can identify information from historical transactions according to specific business nature. Then, they can apply RFM analysis and assign different RFM scores for different customers. From RFM scores, companies can segment their consumers by applying K-means clustering to obtain several clusters based on their needs. Fourthly, cluster CLV can be calculated by using fuzzy AHP weights and RFM algorithms. According to companies' regulations, cluster CLV, rankings of clusters can be obtained, and various business retention strategies can be implemented.

From the proposed approach in this research, eCommerce companies can perform a customercentric strategy to enlarge each cluster's CLV to increase consumer loyalty. Firms that are small and that are holding limited resources, especially, can,

therefore, focusing more on the strategies that attract the most valuable clusters instead of spending more resources on unworthy marketing strategies. For in eCommerce companies, by managers implementing this approach, CRM practices can change to straightforward usage of existing information traceable on eCommerce platforms rather than traditional CRM practices such as tagging consumers by supposing their demographical profile according to limited information. Then, companies can also raise strategies for different clusters according to their current goals.

ACKNOWLEDGMENTS

In this research, this approach is suitable for companies with a smaller database, high product prices, and low customer retention rates. For companies that are higher in retention rate but smaller price gaps, results of customer segmentation based on RFM model need to be verified. For some eCommerce companies that are relatively new and do not obtain many transactions, this approach may also be unsuitable due to limited customer records. In some companies, implementing K-means clustering can also be challenging as well. Future research needs to extend on: firstly, the proposed approach can be suitable for eCommerce companies that are higher in customer retention rate but lower in product prices. Secondly, further research can be concentrated on other implementations of RFM model, for instance, WRFM and many others for eCommerce companies that are operating in different 45 industries. Many other implications of the RFM model include other criteria, which create more combinations of scoring and might be suitable for vast customer databases. Thirdly, companies operating in retailing can also estimate the effectiveness by implementing this approach.

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DISTANCE LEARNING

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Abstract - The pandemic situation has brought new challenges for higher education institutions. Distance learning has become a major issue on the agenda. Tbilisi Humanitarian Teaching University managed to switch to distance learning mode instantly. The University uses Zoom, Model platforms to facilitate distance learning. The guidelines and video tutorials have been developed for academic staff and students. Online lectures are recorded and uploaded to the appropriate platform and are available for all students. Depending on the actual situation, students are offered a flexible individual payment schedule.

Keywords - Pandemic Situation, Distance Learning

I. INTRODUCTION

Education in which the main elements include physical separation of teachers and students during instruction and the use of various technologies to facilitate student-teacher and student-student communication. Distance learning traditionally has focused on nontraditional students, such as full-time workers, military personnel, and nonresidents or individuals in remote regions who are unable to attend classroom lectures. However, distance learning has become an established part of the educational world, with trends pointing to ongoing growth.

Various terms have been used to describe the phenomenon of distance learning. Strictly speaking, distance learning (the student's activity) and distance teaching (the teacher's activity) together make up distance education. Common variations include e-learning or online learning, used when the Internet is the medium; virtual learning, which usually refers to courses taken outside a classroom by primary- or secondary-school pupils (and also Internet); correspondence typically using the education, the long-standing method in which individual instruction is conducted by mail; and open learning, the system common in Europe for learning through the "open" university.

Four characteristics distinguish distance learning. First, distance learning is by definition carried out through institutions; it is not self-study or a nonacademic learning environment. The institutions may or may not offer traditional classroom-based instruction as well, but they are eligible for accreditation by the same agencies as those employing traditional methods.

Second, geographic separation is inherent in distance learning, and time may also separate students and teachers. Accessibility and convenience are important advantages of this mode of education. Well-designed programs can also bridge intellectual, cultural, and social differences between students. Third, interactive telecommunications connect individuals within a learning group and with the teacher. Most often, electronic communications, such as e-mail, are used, but traditional forms of communication, such as the postal system, may also play a role. Whatever the medium, interaction is essential to distance education, as it is to any education. The connections of learners, teachers, and instructional resources become less dependent on physical proximity as communications systems become more sophisticated and widely available; consequently, the Internet, mobile phones, and e-mail have contributed to the rapid growth in distance learning.

Finally, distance education, like any education, establishes a learning group, sometimes called a learning community, which is composed of students, a teacher, and instructional resources-i.e., the books, audio, video, and graphic displays that allow the student to access the content of instruction. Social networking on the Internet promotes the idea of building. On community sites such as Facebook and YouTube, users construct profiles, identify members ("friends") with whom they share a connection, and build new communities of likeminded persons. In the distance learning setting, such networking can enable students' connections with each other and thereby reduce their sense of isolation [1].

II. THE BODY

The distance learning issue became especially relevant in 2020. Before the pandemic the practice of distance learning was not introduced in Georgia, as in general, distance education was not considered as a recognized form of education. The pandemic situation has brought new challenges for higher education institutions. Distance learning has become a major issue on the agenda.

Distance Learning - an organized educational process or part of it, based on information-communication technologies organized in the higher education institutions of Georgia for obtaining education at any level, using remote/electronic form or other means of

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communication which does not require simultaneous presence of a student and the staff of a higher education institution at a specific place [2].

Distance learning is carried out in the synchronous or asynchronous communication form. Synchronous communication refers to an interaction when the communication between the sender and the receiver of the information takes place simultaneously, and likewise, asynchronous communication refers to an interaction when the communication between the sender and the receiver of the information is not simultaneous [2]. There is also a mixed form of distance learning that involves both synchronous and asynchronous elements. These forms of distance learning have both strong and weak points. The positive side of the synchronous form can be that students have the opportunity to receive real-time feedback from the lecturer, on the other hand this form of teaching requires relatively more resources [3].

Asynchronous teaching gives the student opportunity to fulfill the lecturer's assignment during a certain period of time. He/she can review the information provided for the educational purpose several times. The weak point of this method increased interval between the student and the lecturer communication process [4]. The pandemic has made technology even more urgent and needed in the education process. Learning process has moved to a digital world where teachers and students are virtually connected.

Tbilisi Humanitarian Teaching University managed to switch to distance learning mode instantly. The University uses Zoom, Moodle platforms to facilitate distance learning.

The University has developed guidelines, video tutorials for the selected distance learning platforms, and made them available to students, academics and invited staff.

The University provided trainings for all program students and as well as for all lecturers.

Online lectures are recordedand uploaded to the appropriate platform and are available for all students. Depending on the actual situation, students are offered a flexible individual payment schedule.

According to survey most of the students and lecturers consider the lack of direct communication as one of the disadvantages of distance learning. Also, students also see the fact that distance learning does not include student life at all as negative point.

A certain percentage of students consider distance education to be a flexible and comfortable. Another advantage of this form of learning is that it is time saving [5].



Here's a list of questions to include in distance learning survey for students:

- 1. How do you feel overall about distance education?
- 2. Do you have access to a device for learning online?
- 3. What device do you use for distance learning?
- 4. How much time do you spend each day on an average on distance education?
- 5. How effective has remote learning been for you?
- 6. How helpful your University has been in offering you the resources to learn from home?
- 7. How stressful is distance learning for you during the COVID-19 pandemic?
- 8. Do you enjoy learning remotely?
- 9. How helpful are your teachers while studying online?

Here's a list of questions to include in distance learning survey for teachers:

- 1. How is your University delivering distance learning?
- 2. Do you have high-speed internet at home?
- 3. Do you have access to a device for learning online?
- 4. What device do you use for distance learning?
- 5. Are you satisfied with the technology and software you are using for online teaching?
- 6. How helpful your University has been offering you the resources to teach from home?
- 7. How helpful your co-workers have been while teaching from home?
- 8. How stressful do you find teaching remotely during the COVID-19 pandemic?
- 9. How stressful were your students while learning remotely during the COVID-19 pandemic?
- 10. How was your experience teaching students from home as compared to teaching at school?
- 11. How well could you maintain a work-life balance while teaching remotely? (Consider 5 being extremely well and 1 being not at all)
- 12. Are you enjoying teaching your students remotely?
- 13. What kind of response have you got so far from your students?
- 14. How peaceful is the environment at home while teaching?
- 15. How important is the role of technology in remote learning?

- 16. How important is face-to-face communication for you while teaching remotely?
- 17. How often do you have a 1-1 discussion with your students?
- 18. Generally speaking, how helpful have parents been while supporting their children's remote learning?
- 19. Are your students learning as much now as they were before switching to remote learning?
- 20. How can your University support you further?

III. CONCLUSION

When it is impossible to carry out the educational process in the traditional way, there exists an alternative way. Of course, distance learning cannot replace the traditional way of learning however it is the only alternative way in conditions of force majeure.

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STUDENT CO-CREATED ONLINE ASSESSMENT

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Abstract - The pandemic has accelerated the move of Higher Education institutions to deploy information and communication technologies for teaching and practice, which created new opportunities and challenges. The ubiquity of exams as form of student assessment presented problems in relation to the integrity of the assessment process and, coupled with the myriad of legal and pedagogical issues raised by proctoring technologies, there was a need to redefine some aspects of the assessment process and fostering different forms of assessment online. As exams have been largely understood to represent a reliable, valid, cost-effective, accepted and with appropriate educational effect form of evaluating students fulfilment of learning objectives, their extensive use created a sometimes unconscious resistance to explore new forms of assessment. On top of that, it can be argued that the above-mentioned understanding was based on assuming unrealistic homogeneity within the student body, resulting in lack of inclusivity and observed disparity of students' performance of diverse backgrounds. Based on current transactional and transactional theories of learning, the paper discusses multiple entry case-study and self-reflective profiles, as examples of assessment methods designed to fulfil all the requirements of a valid form of assessment, but also including the student decision and interests, to create a shift in the power dynamics of the evaluation and foster a culture of co-creation that result in a more efficient and inclusive assessment.

Keywords - Online Assessment, Co-creation, Inclusivity, Transactional and Transformational Education

THE EFFECT OF COMPANY CHARACTERISTICS MEDIATION ON CORPORATE GOVERNANCE MECHANISM AND EARNING QUALITY (EMPIRICAL STUDY OF PUBLIC COMPANIES IN ASEAN COUNTRIES)

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Abstract - This study presents empirical evidence of the mediating effect of firm characteristics (strategy and profitability) on the relationship between the application of corporate governance mechanisms (number of commissioners, the ratio of independent commissioners, audit committee members with accounting and finance education background, percentage of public ownership in the company's stock composition) with earning quality of public companies in five ASEAN countries (Indonesia, Malaysia, Singapore, the Philippines, and Thailand). Earnings quality is measured by multi measurements (accrual quality, persistence, predictability, variability, and smoothing). The analysis uses the regression method with the results that corporate strategy does not mediate the relationship between corporate governance and earnings quality, but profitability (ROA) mediates the earnings quality of public companies in Malaysia, the Philippines, and Thailand.

Keywords - Corporate Governance Mechanism, Earnings Quality, Mediation, Corporate Strategy, Profitability

A QUALITY IMPROVEMENT PROJECT TO LOOK FOR INCIDENCE OF ALTERNATE COLONIC PATHOLOGY AFTER RESOLUTION OF SIGMOID DIVERTICULITIS

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Abstract -

Aims: The study aims to look at the endoscopic examination findings for all those patients who were managed without an operative intervention and who underwent a subsequent examination of colon after resolution of acute sigmoid diverticulitis. The study also aims to look at histopathological findings of tissues that were sampled during the colonic examination and was compared with other studies available in literature.

Methods: Retrospective study and all patients admitted and treated conservatively for acute sigmoid diverticulitis over a period of 1 year.

Results: More than 18% of patients had a colonic polyp excised after an endoscopic examination of the colon. None of the polyps were malignant. However, almost 44% of patients had hyperplastic polyp, 37% of patients had tubular adenoma and 6% of patients showed a tubulo-villous architecture in histology.

Conclusion: The rate of colonic polyps retrieved was much higher when compared to previous studies. Malignancy was not identified in any of the biopsies that were performed that can be attributed for small prevalence in identification of colorectal malignancy after acute diverticulitis and also small sample size of the study.

A SIMULATOR STUDY TO ESTIMATE THE SAFEST PLACE TO REMAIN AT ANCHOR AND DRIFT DURING HEAVY WEATHER FOR A SHIP CLOSE TO COLOMBO HARBOUR

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Abstract - In the wake of two recent major ship accidents, in Sri Lankan waters, with disastrous environmental consequences there emerges the great need of frequent scientific analysis and evaluations of environmental safety pertaining to the shipping industry. This requires amending, renewing and updating the instructions issued by the port authority to ships calling Sri Lankan ports. However, very few prior research has been carried out to evaluate safe positions for a disabled ship to drift or remain at anchor without running aground for an adequate period to allow the response parties to arrange and execute a solution. This simulator-based study evaluates best possible places in terms of drifting period, direction, and possible points of grounding in different weather and sea conditions. The full mission bridge simulator at CINEC campus and experts in marine simulation comprise the resources for the experiment. This study uses two container ship models positioned in various places near Colomboharbour in disabled state and measures their drift, set, points of grounding in slight, moderate, and rough seas while wind conditions applied in par with monsoon seasons. The findingsidentify best possible places for a disabled ship to drift or remain at anchor near Colombo harbour for a safe duration. This study is limited to Colombo due to unavailability of developed simulation areas in other parts of Sri Lanka and only container ship modes will be used since Colombo is a container port chiefly. The environmental and economic significance of this study spreads across the fields of ship handling, crisis management and Maritime sciences.

Keywords - Simulator study, Colombo Harbour, Maritime Disaster Avoidance



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