

Development of General Chemistry Learning Media (Thermochemistry) Using Web Based Learning Model

Freddy Tua Musa Panggabean
Chemistry Education Study
Program
Faculty of Mathematics and
Natural Science
Universitas Negeri Medan
Medan, North Sumatera,
Indonesia

Pasar Maulim Silitonga
Chemistry Education Study
Program
Faculty of Mathematics and
Natural Science
Universitas Negeri Medan
Medan, North Sumatera,
Indonesia

Marudut Sinaga
Chemistry Education Study
Program
Faculty of Mathematics and
Natural Science
Universitas Negeri Medan
Medan, North Sumatera,
Indonesia

Ani Sutiani
Chemistry Education Study
Program
Faculty of Mathematics and
Natural Science
Universitas Negeri Medan
Medan, North Sumatera,
Indonesia

Jamalum Purba
Chemistry Education Study
Program
Faculty of Mathematics and
Natural Science
Universitas Negeri Medan
Medan, North Sumatera,
Indonesia

Abstract: The use of innovative and constructive learning media in reconstructing students' knowledge, abilities and creativity is something that a lecturer needs to consider. One of the media that can be applied in the learning process is learning media using web based learning. This research and development aims to describe the feasibility (validity), effectiveness and improvement of student learning outcomes through learning media using a web based learning model that was developed in general chemistry learning of thermochemical material through the ADDIE development model. This research and development resulted in books and learning media for General Chemistry on thermochemical material using a web based learning model that has been declared valid (appropriate) and has been proven to be effective in improving student learning outcomes. Validity is met qualitatively based on the assessment of the validators of material experts and media experts. Effectiveness is met based on the results of implementation and proven by statistical hypothesis testing ($p < 0.05$) with the average value of the pretest-posttest difference or an increase in student learning outcomes of $25,633 \pm 7,739$.

Keywords: Learning media, general chemistry, thermochemistry, WBL

1. INTRODUCTION

One of the main problems in the education system in Indonesia is the problem of the quality and outcomes of the learning process. This problem is related to the provision of learning materials and materials that are not widely accessible without being limited by distance and time constraints [1]. In addition, the development of modernization and globalization of the 21st century has also had a tremendous impact in all fields including education [2]

Since the advent of optical cable technology and web browsers, the flow of information spread around the world has become increasingly out of control and has resulted in the so-called 'digital information explosion'. Through a search engine, one can easily find the desired reference material in real time at a very, very low cost. All of this is possible because teaching materials and interaction processes have been successfully digitized by technological advances [3].

The rapid development of information and communication technology has also changed the order of human life. Education in the 21st century has been in the knowledge age with the acceleration of extraordinary increases in knowledge and is supported by the application of media and digital technology called the information super highway. The style of

learning activities in the knowledge age must be adapted to the needs of the knowledge age [4].

Learning materials must provide a more authentic design for going through challenges where students can collaborate to create solutions to solve learning problems. Problem solving leads to questions and searches for answers by students which can then be searched for problem solving in the context of learning using available information resources [5].

21st century learning also demands many things from a teacher or lecturer, especially those related to abilities and skills. In its first role, the teacher or lecturer prepares students to be able to have 21st century skills [6].

21st century learning has the main goal of building students' learning abilities and supporting the development of students to become lifelong, active, independent learners. The demands for professionalism of 21st century educators are not on the ability of educators to know and be proficient about everything, but educators have the expertise to find out together with their students, become role models of trust, openness, and perseverance to their students to face the realities of digital life in the 21st century [7].

21st century learning is required to be technology-based to balance the demands of the millennial era with the aim that

students will become accustomed to 21st century life skills. Students living in the 21st century must master science, metacognitive skills, be able to think critically and creatively, and be able to communicate or collaborate effectively. effective, this situation illustrates the gap between expectations and reality [8]

Along with the development of technology and information in the digital era of the 21st century today, efforts to improve the quality of learning can be carried out through the use of technology in a system known as online learning [9].

The characteristics of online learning include: a) relying on the independence of students in learning, b) the use of computer-based electronic media, c) the use of various functions of electronic media so-called Multimedia, and d) the use of hardware, software, and internet networks. The key to success in an online class is not what technology is used but how it is used and what information is communicated using that technology [10].

The learning process is basically a communication process that involves delivering messages (material) from the instructor (teacher or lecturer) to the recipient (students), and in the process of delivering the message, a media is needed so that the message can be well received. Media is one of the important components in a communication process, including in the learning process [11].

Learning media is a communication channel tool, the media comes from Latin which has the meaning of an intermediary between the source of the message and the recipient of the message. Media are various types of components in the student environment that can provide stimulation for learning [12]. Learning media is anything that can be used to transmit messages from sender to receiver so as to stimulate the thoughts, feelings, concerns and interests and willingness of students in such a way that the learning process occurs in order to achieve learning objectives effectively [13], that can help students to achieve learning goals [14].

The technique of using and utilizing media in its implementation also contributes greatly in attracting the attention of students in the learning process, because basically the media has two main functions, namely the media as a tool and the media as a learning resource for students [15].

The use of innovative and constructive learning media in reconstructing students' knowledge, abilities and creativity is something that a lecturer needs to consider. Therefore, a lecturer needs to plan innovative and creative strategies, teaching materials and learning media by utilizing technology-based learning.

Utilization of technology is one of the efforts made for learning media, so that learning does not have to be done face-to-face between educators and students [16]. One of the media that can be applied in the learning process is learning media using web based learning.

The Web or often referred to as the WWW which stands for World-Wide Web is the latest means to navigate cyberspace. The web is a distributed internet service with the concept of hypertext between documents related to the HTML (Hyper Text Mark Up Language) language for document format. [17].

Website is the entire web page contained in a domain that contains information. A website usually consists of many interconnected web pages [18]. The Web facilitates a student-centered approach, creating a motivating, active and flexible learning environment. The web can be used as a learning

medium to make it easier for students to understand concepts or learning materials [19].

Web Based Learning is a system that can communicate easily by utilizing internet facilities so that communication activities can be carried out without being limited by distance, place and time [20]. Web based learning (web-based learning) is learning related to teaching materials presented through web browsers such as internet explorer, mozilla firefox, opera, netscape, and others [21] [1]. Web Based Learning is a distance learning system based on information technology through between web pages [17].

To make Web Based Learning into the form of the internet and can be implemented in the form of online learning, it is necessary to use the programming language in it. Programming languages that are usually used to create internet-based application programs include HTML, Java, PHP and so on. PHP (Hypertext Preprocessor) is one of the web-based programming languages. PHP is server-side programming, meaning that the PHP code written will be executed on the server side so that visitors cannot see the source code of the PHP script that was built. In addition to using the PHP programming language to design Web Based Learning, it also requires a database as a storage medium to accommodate many questions and also learning applications, the database used is MySQL [17].

Web-based learning media that utilizes information and communication technology is very helpful for teachers in carrying out learning activities. In addition, students can also be helped with easy access and learning activities using the internet and to help students understand lessons easily and can be learned by students anytime and anywhere. Web-based learning media can be equipped with various interesting learning materials so that they can direct students to do real practice in the learning process, the learning process can be carried out more effectively and efficiently. In addition, the learning process can also be an arena for asking questions, motivation and enthusiasm that is more interesting for students in independent learning [22].

Based on the phenomena and descriptions above, it is necessary to develop General Chemistry learning media using the Web Based Learning model which is expected to support the implementation of an effective and efficient learning process, as well as the limited time in face-to-face learning (conventional) can be replaced and given online access using media web-based learning. Utilization of learning media using the Web Based Learning model is also expected to increase the efficiency of student learning outcomes.

2. METHOD

To answer research problems, the method used is a development method that refers to the ADDIE development model. The ADDIE development model uses 5 stages as the name implies, namely: Analysis, Design, Development, Implementation, and Evaluation [4]. The research procedure is carried out through stages, including: (a) Analysis, namely conducting analysis to collect information related to student needs and reviewing literature related to the product being developed; (b) Design, which is the stage carried out to identify the objectives and make the design of General Chemistry learning media for thermochemical materials using a web based learning model that will be developed; (c) Development, is the stage to realize the design into a product that is ready to be implemented; (d) Implementation, namely

implementing General Chemistry learning media products for thermochemical materials using a web based learning model; and (e) Evaluation, which is to evaluate by analyzing the effectiveness of the General Chemistry learning media on thermochemical material using a web based learning model on student learning outcomes.

The techniques and instruments used in this study include (a) interviews used for data collection when conducting research as a preliminary study material to look for problems to be studied and used in product trials both at the time of validation to experts and product trials in the field as consideration in improving the teaching materials developed; (b) the validation sheet used to obtain data on the results of the expert's validation of the General Chemistry learning media for thermochemical material using a web based learning model developed to test its feasibility or validity; and (c) a test instrument designed to obtain data on the achievement of student learning outcomes in thermochemistry learning. The test is structured and developed in accordance with the indicators and competencies of the achievement of the General Chemistry course on thermochemical material.

The data obtained in the form of qualitative and quantitative data. Qualitative data were obtained from the assessment, advice and input of media expert validators and material experts based on the expert validation sheet instrument. Quantitative data was obtained from the achievement of student test results through tests on thermochemical material. The effectiveness and improvement of student learning outcomes were analyzed using a t-test with a paired sample t-test approach with the help of the SPSS program.

3. RESEARCH RESULT

The product developed in this study is a general chemistry learning media using a web based learning model. General Chemistry learning media using a web based learning model was compiled and developed with the aim of making it easier for lecturers and students in the General Chemistry learning process. The validation or feasibility of general chemistry learning media using a web based learning model is evaluated by expert validators in their field. The products produced and have been declared feasible by expert validators are then applied to students to analyze the effectiveness of the products produced.



Figure 1. General chemistry learning book/media model of web based learning

3.1 Product Feasibility

The feasibility (validity) of General Chemistry learning media using the developed web based learning model is evaluated and assessed by expert validators based on the feasibility of the material and the feasibility of the media.

Table 1. Validation results on material aspects

Aspect	Mean Score		Total Mean	Criteria
	I	II		
Content	4.33	4.00	4.17	Valid
Presentation	4.33	4.33	4.33	Valid
Language	4.40	4.40	4.40	Valid
Graphics	4.22	4.20	4.21	Valid
Total Mean			4.28	Valid

Table 1 shows the results of material expert validation, the average total score is 4,28 or is declared valid. Thus, based on the results of the material expert validator's assessment, it was concluded that the General Chemistry learning media on Thermochemistry material using a web based learning model was valid or feasible to be applied in the learning process.

Table 2. Validation results on the media aspect

Aspect	Mean Score		Total Mean	Criteria
	I	II		
Software engineering	4.40	4.40	4.40	Valid
Interface view	4.22	4,00	4.11	Valid
Verbal communication	4.25	4.13	4.19	Valid
Total Mean			4.23	Valid

Table 2 shows the results of media expert validation, the average total score is 4,23 or is declared valid. Thus, based on the results of the media expert validator's assessment, it was concluded that the thermochemical material in General Chemistry learning media using a web based learning model was valid or feasible to be applied in learning.

3.2 Achievement of Student Learning Outcomes

The achievement of student learning outcomes is obtained through tests given before and after utilizing the material on General Chemistry learning media using a web based learning model. This stage was carried out to 30 students and carried out in 3 (three) stages including: (1) the initial stage, namely the initial test (pretest) before the students were given action, (2) the second stage, namely the learning process where students learn online by utilizing the material on the internet. General Chemistry learning media using a web based learning model that has been produced, and (3) the third stage, namely the final test (posttest).

Table 3. Student learning outcomes

Data	Min	Max	Mean	Std. Dev.	K-S Test	Sig
Pretest	37	73	58.83	8.647	.149	.086
Posttest	63	100	84.47	9.247	.141	.130

Table 3, shows the achievement of the students' pretest results before being given the action, the average value was $58,83 \pm 8,647$ and the data had a normal distribution with the Kolmogorov-Smirnov test of 0,149 and $p = 0,086$. After taking action by utilizing the learning media of General Chemistry using thermochemical material using a web-based learning model, the posttest results obtained an average student score of $84,47 \pm 9,247$ and the data has a normal distribution with the Kolmogorov-Smirnov test of 0,141 and $p = 0,130$.

3.3 Product Effectiveness

The effectiveness of General Chemistry learning media using the developed web-based learning model was analyzed from the increase in student learning outcomes in completing tests using a pretest-posttest design. The test results were analyzed using a paired sample t-test approach using the SPSS program.

Table 4. Product effectiveness test results

Pair	Posttest -pretest	Paired Differences		t	df	Sig (2-tailed)
		Mean	Std. Deviation			
1		25.633	7.739	18.141	29	.000

Tabel 4, diperoleh nilai t_{hitung} sebesar 18,141 dengan probabilitas (sig.) sebesar $0,000 < 0,05$ sehingga disimpulkan bahwa implementasi media pembelajaran Kimia Umum pada materi termokimia menggunakan model *web based learning* yang dihasilkan terbukti efektif dalam meningkatkan pencapaian hasil belajar mahasiswa dengan selisih rata-rata nilai (posttest-pretes) sebesar $25,633 \pm 7,739$.

The product developed in this research and development is in the form of general chemistry learning media for thermochemical material using a web based learning model by taking into account the material and media aspects. The results of the assessment of practitioners and expert validators on General Chemistry learning media using the developed web-based learning model have been declared valid and feasible to be applied in learning. The validity of the general chemistry learning media using the web based learning model is met qualitatively based on the assessments of the material expert validators and media expert validators which are overall stated in the valid category.

The implementation of General Chemistry learning media on thermochemical material using a web based learning model has also proven effective in improving student learning outcomes. The effectiveness is met statistically based on the increase in students' ability to complete the tests carried out. Student responses to General Chemistry learning media using the resulting web-based learning model are also very positive.

The findings of this research and development have implications for lecturers that to improve the ability and achievement of student learning outcomes, it can be done by

developing innovative learning and one of them is General Chemistry learning media using a web based learning model. Through general chemistry learning media using this web based learning model, it can help students improve their understanding, mastery and abilities.

4. CONCLUSION

This research and development resulted in books and learning media for General Chemistry on Thermochemistry using a web based learning model. General Chemistry learning media using a web based learning model was developed through the ADDIE development model and has been declared valid (feasible) and proven effective to improve student learning outcomes. The validity (feasibility) is met qualitatively based on the assessment (validation) of the material expert validators and media experts which are overall stated in the valid category. The effectiveness is fulfilled based on the implementation of General Chemistry learning media using a web based learning model and is proven from the results of statistical hypothesis testing with a probability value of $< 0,05$. The increase in student learning outcomes is evidenced by the increase in student learning outcomes before and after using General Chemistry learning media using the resulting web-based learning model. The mean value of the pretest-posttest difference or increase in student learning outcomes is $25,633 \pm 7,739$.

5. ACKNOWLEDGEMENTS

We acknowledge LPPM Universitas Negeri Medan for providing our research, and indeed all respondents and supervisors who supported with this project.

6. REFERENCES

- [1] J. Rahmadoni, "Perancangan Simulasi Pembelajaran Kriptografi Klasik Menggunakan Metode Web Based Learning," *Intecom J. Inf. Technol. Comput. Sci.*, vol. 1, no. 1, pp. 34–43, 2018.
- [2] F. T. M. Panggabean, P. M. Silitonga, and M. Sinaga, "Development of CBT Integrated E-Module to Improve Student Literacy HOTS," *Int. J. Comput. Appl. Technol. Res.*, vol. 11, no. 05, pp. 160–164, 2022, doi: 10.7753/IJCATR1105.1002.
- [3] Afandi, T. Junanto, and R. Afriani, "Implementasi Digital-Age Literacy dalam Pendidikan Abad 21 di Indonesia," in *Seminar Nasional Pendidikan Sains*, 2016, pp. 113–120.
- [4] J. Purba, F. T. M. Panggabean, and A. Widarma, "Development of Online General Chemistry Teaching Materials Integrated with HOTS-Based Media Using the ADDIE Model," *Int. J. Comput. Appl. Technol. Res.*, vol. 11, no. 05, pp. 155–159, 2022, doi: 10.7753/IJCATR1105.1001.
- [5] M. Q. W. Aji, "Mengembangkan Kecakapan Abad 21 Mahasiswa Melalui Model Pembelajaran Inkuiri," *Teknodika J. Penelit. Teknol. Pendidik.*, vol. 17, no. 02, pp. 70–84, 2019.
- [6] F. T. M. Panggabean and J. Purba, "Pengembangan E-Modul Terintegrasi Media Berbasis Adobe Flash CS6 Untuk Meningkatkan Kemampuan Pemecahan Masalah Kimia Mahasiswa," *J. Inov. Pembelajaran Kim. (Journal*

- Of Innovation in Chemistry Education*), vol. 3, no. 2, pp. 116–122, 2021.
- [7] R. D. Prayogi and R. Estetika, “Kecakapan Abad 21 : Kompetensi Digital Pendidik Masa Depan,” *J. Manaj. Pendidik.*, vol. 14, no. 2, pp. 144–151, 2019.
- [8] L. Sugiyarti, A. Arif, and Mursalin, “Pembelajaran Abad 21 di SD,” in *Prosiding Seminar dan Diskusi Nasional Pendidikan Dasar*, 2018, pp. 439–444.
- [9] F. T. M. Panggabean, P. O. Pardede, R. M. D. Sitorus, Y. K. Situmorang, E. S. Naibaho, and J. S. Simanjuntak, “Application of 21st Century Learning Skills Oriented Digital-Age Literacy to Improve Student Literacy HOTS in Science Learning in Class IX SMP,” *J. Mantik*, vol. 5, no. 36, pp. 1922–1930, 2021.
- [10] P. Pannen, *Kebijakan Pendidikan Jarak Jauh dan E-Learning di Indonesia*. Jakarta: Kemenristek Dikti, 2016.
- [11] F. T. M. Panggabean, J. Purba, and M. Sinaga, “Pengembangan Pembelajaran Daring Terintegrasi Media Untuk Mengukur HOTS Mahasiswa Pada Mata Kuliah Kimia Organik,” *J. Inov. Pembelajaran. Kim. (Journal Of Innovation in Chemistry Education)*, vol. 3, no. 1, pp. 11–21, 2021.
- [12] M. Fransisca, “Pengujian Validitas, Praktikalitas, dan Efektivitas Media E-Learning di Sekolah Menengah Kejuruan,” *J. Ilm. Pendidik. Tek. Elektro*, vol. 2, no. 1, pp. 17–22, 2017.
- [13] I. Wahyudi, “Pengembangan Program Pembelajaran Fisika SMA Berbasis E-Learning dengan Schoology,” *J. Ilm. Pendidik. Fis. Al-BiRuNi*, vol. 6, no. 2, pp. 187–199, 2017, doi: 10.24042/jipfalbiruni.v6i2.1850.
- [14] N. R. Wahyuaji and Suparman, “Deskripsi Kebutuhan Media Pembelajaran E-Learning Berpendekatan STEM Untuk Mengembangkan Kemampuan Berpikir Kritis dan Kreatif Siswa SMA Kelas XI,” *Semin. Nas. Pendidik. Mat. Ahmad Dahlan*, pp. 194–199, 2018.
- [15] A. H. Elyas, “Penggunaan Model Pembelajaran E-Learning dalam Meningkatkan Kualitas Pembelajaran,” *J. War.*, vol. 56, no. April, pp. 1–11, 2018.
- [16] J. F. Sinuraya and J. B. N. B. Barus, “Minat Mahasiswa Program Studi Pendidikan Olahraga dalam Mengikuti Pembelajaran E-Learning di Universitas Quality Berastagi,” *J. Educ. Hum. Soc. Sci.*, vol. 4, no. 1, pp. 526–534, 2021, doi: 10.34007/jehss.v4i1.692.
- [17] K. Siregar, “Perancangan Prototype Aplikasi Pembelajaran Budaya Batak Menggunakan Metode Web Based Learning (WBL),” *JUKI J. Komput. dan Inform.*, vol. 1, no. 1, pp. 39–45, 2019.
- [18] M. A. Ihsan, T. R. Liza, D. Setiawan, and Asmaidi, “Web-Based Learning Media Application,” *J. Mantik Penusa*, vol. 3, no. 2, pp. 51–54, 2019.
- [19] V. D. Susanti, T. Andari, and A. F. Harenza, “Web-Based Learning Media Assisted By Powtoon in Basic Mathematics Course,” *Al-Jabar J. Pendidik. Mat.*, vol. 11, no. 1, pp. 11–20, 2020.
- [20] S. Bakti, N. A. Hasibuan, L. T. Sianturi, and R. D. Sianturi, “Perancangan Aplikasi Pembelajaran CorelDraw X3 Menggunakan Metode Web Based Learning,” *J. Ris. Komput.*, vol. 3, no. 4, pp. 32–35, 2016.
- [21] R. Firmansyah and I. Saidah, “Perancangan Web Based Learning sebagai Media Pembelajaran Berbasis ICT,” *Informatika*, vol. 3, no. September, pp. 176–182, 2016.
- [22] H. D. Saputra, N. Nasrun, and W. Wakhinuddin, “Development of Web-Based Learning Media in Vocational Secondary School,” *Volt J. Ilm. Pendidik. Tek. Elektro*, vol. 3, no. 1, pp. 37–41, 2018.

Best French Android-Based Educational Game For Beginner-Level French Language Learners

Pengadilen Sembiring
French Language Education, Faculty of
Language and Art, Universitas Negeri Medan,
Medan, North Sumatera, Indonesia

Reni Rahmadani*
Electrical Engineering Education Department,
Faculty of Engineering, Universitas Negeri
Medan, Medan, North Sumatera, Indonesia

Baharuddin
Electrical Engineering Education Department,
Faculty of Engineering, Universitas Negeri
Medan, Medan, North Sumatera, Indonesia

Hesti Fibriasari
French Language Education, Faculty of
Language and Art, Universitas Negeri Medan,
Medan, North Sumatera, Indonesia

Rizki Fadila Nasution
Indonesian Language and Literature, Universitas
Negeri Medan, Medan, North Sumatera,
Indonesia

Abstract: In this study, the product that will be produced is in the form of an android-based "Best French" Educational Game Media Application designed to make it easier for beginner-level learners in learning, especially learning vocabulary intended for French is a language that is in great demand after English. In addition, French is one of the languages studied in many schools and universities in Indonesia. Although it is in great demand by many people, in the early stages of introducing linguistic rules, it is still difficult to learn French because the grammatical structure and vocabulary are very different from Indonesian. French learning in the early semester, especially in vocabulary learning, needs to be optimized. Therefore, to improve vocabulary mastery, it is necessary to have more interesting learning supported by an appropriate learning medium, namely the maximum use of technology accompanied by interesting material. One of the developments of learning media that can help beginners in learning French is educational games. This study aims to: (1) to design and implement the Best French Android-Based Educational Game. (2) to find out the user's response to the Best French Android-Based Educational Game. The research method used is research and development with the ADDIE (Analysis, Design, Development, Implementation, and Evaluations) model. The features contained in the Best French Educational Game include learning and playing features. In the learning feature, there are letter recognition materials, vocabulary, and conversation patterns while in the playing feature, the material studied is tested in game mode.

Keywords: Educational Games, Android, French Language

1. INTRODUCTION

In an effort to socialize and exchange information humans need a globally understandable disclosure tool, namely language. Therefore, in this increasingly advanced era, especially in the international arena, we are required to be able to master foreign languages, one of which is French. French is a language that is in great demand after English. In addition, French is one of the languages studied at several well-known universities in Indonesia. Thus, choosing French as one of the study programs taught in a higher education level environment is an effort to produce French scholars or linguists in Indonesia.

French language learning, especially vocabulary learning, needs to be optimized. Therefore, to improve vocabulary mastery, it is necessary to have more interesting learning supported by an appropriate learning medium, namely the maximum use of technology accompanied by interesting learning. Vocabulary is the underlying thing that mastering the language because vocabulary is needed by a person to carry out language activities, namely listening, speaking, reading,

and writing. The basic concept of teaching vocabulary is to teach mastery of vocabulary with its meaning. However, word mastery is not only limited to being able to use words in sentences but also being able to add new words and understand their meanings and attach these new words to the student's memory because the more vocabulary the student has, the easier it will be to convey and receive information in the process of learning languages, especially French. Each nomina in French is classified into two categories, namely the masculine nomina and the feminine nomina. The next thing that needs to be understood is that the French nomina cannot stand alone without the word clothing accompanying it. This is certainly different from nouns in Indonesian. The big question of where the french noun type division came from has not been solved until recently, since this rule has existed since the use of old French (ancien français). Roshental (2004), states that French language learners are required to master (memorize) the classification of masculine nomina and French femina.

Based on the responses of students, especially new students in the analysis questionnaire in the first semester that

in the aspects of learning methods and tools, "enough" scores were obtained with the statement that during the Covid-19 pandemic, which has been two years of lectures and online learning with all existing obstacles, both internal and external, making learning less interesting and lacking clarity about the material being studied, and does not take place interactively. The need for interactive media and learning aids for students can be understood because the illustrations provided are not always adequate, not continuous, for mastery of contextual French grammar. This fact has an impact on some students who do not master grammar and lack the vocabulary of the French language that has been learned. This shows that there is still a C grade in the final exam results of the odd semester of the last year. Researchers found several factors that may be behind students' difficulties in learning French. These factors include (1) students' assumptions about French learning that is less useful for daily life, (2) the lack of use of technological media by students in French language learning, (3) online learning conditions that do not provide direct vocabulary feedback from lecturers, this causes a lack of understanding of students in the French learning process.

Based on the description above, researchers will develop French learning media that can be used by applying French learning using the game method. French language learning facilities with the game method are one of the innovations that are much loved by young people. Android-based educational games were chosen because currently, mobile phones with their operational systems are very close to students. The use of Android-based educational game media for learning les articles with the theme of Les goûts and La Vie Quotidienne in French is still relatively rare. The reality on the ground prompted researchers to develop Android-based educational games to assist students in learning French tutoring in the first semester.

2. METHODS

Research using a research and development process that tests the effectiveness of the product is carried out in the Unimed French Language Education Study Program. The research time was carried out in January-September 2022. The research subjects in this development research consisted of 2 media experts, 2 material experts, and 35 students in field trials. Some of the stages carried out in this English genius are as follows:

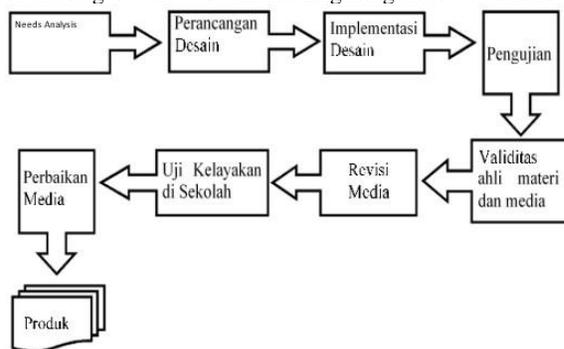


Figure 1. Steps on how to research and develop

1. Analysis Stage. This stage is carried out by exploring the problems that exist in schools that are a priority so that this educational game will be able to help alleviate these problems. At this stage, a classroom observation is

carried out as a place for research. In addition to interviews with lecturers to explore information related to problems in class. The information unearthed between courses is an obstacle and whether the existence of educational game media can help alleviate the problem.

2. Design Stage. At this stage, the formulation of materials and content that will be the main material in educational games, the formulation of levels in the game, and the content in each level are carried out. At this stage, a storyboard is created that contains navigation buttons between pages. From this design, an interface design is then made including background, navigation buttons, material drawing assets, layouts, and so on. In making the design and content of the material, it should be carried out in coordination with the teacher so that if there are shortcomings, they can be corrected immediately so that they do not work twice.
3. Development Stage. The implementation in this process is the provision of program codes of various designs already created. In making program code, it can be formulated into several functions including navigation functions between pages, game interaction functions, score functions, leveling functions, feedback functions, voice functions, and several other functions. After all these functions are created, they are inserted into several pages as needed. After the process is complete, the application will be tested by yourself first until everything goes with the plan. This is in order to work more effectively and when constituted to Media experts and material experts there will not be many revisions that will have to be corrected. The results of suggestions for improvement from media and material experts will be accommodated and will be an improvement of this educational game.
4. Implementation Stage. At this stage, it is carried out by showing the final results of improvements from media experts and material experts. After this educational game is considered feasible, the next step will be for the students to be walked. At this stage, it will also get responses from lecturers and students which will then be improved at the evaluation stage. These responses can be in the form of notes or even assessment results from the exam results before and after running this educational game.
5. Evaluation stage. At this stage, it is aimed at measuring the success of this program which can further become a record for the development process of future versions. At this stage, it is also to capture input from the target audience for the improvement of this game in the next version. To get the data results, it is used using an instrument which in this case is a form to get data from a team of experts and from the audience.

3. RESULTS

Validators for media experts studying researchers entrust to Mrs. Tansa Trisna Astono Putri who is an expert in the field of Informatics and Computer Engineering and is a lecturer in the Informatics and Computer Engineering Study Program, at Medan State University. The assessment aspect in the media expert validation sheet instrument consists of aspects of guidance and information, software operations as well as systematics, aesthetics, and media principles.

The revised results of all errors in the learning media were reviewed by the media expert validator at meeting two, then the validator gave an assessment on the validation sheet instrument. The result of calculating the percentage score from learning media experts at meeting III was 91.4% with an excellent classification. Validation at this meeting of learning media experts gave a positive response to the educational game "Best French".

A. Material Expert Validation Results

The assessment of the French educational game "Best French" in terms of material was assessed by Mrs. Dr. Hesti Fibriasari, M.Hum who is a lecturer in the French language education study program and teaches at the Postgraduate Program at Medan State University and is an expert in the field of linguistics. The purpose of material expert validation is so that the content of the material in the learning media is in accordance with the learning objectives, the actualization of the material content, the usefulness of the learning material, the suitability of the material to the needs of students and the quality of presentation in conveying the concept of the material. The result of the percentage score with 4 aspects assessed by the material expert at the second meeting was 90.6% with a very valid classification. It was concluded that the learning media is worth testing in the field without any revision.

B. Results of Lecturers' Assessment of Interactive Multimedia

The assessment of lecturers who teach the initial semester course on the educational game "Best French" the results of the assessment of the educational game "Best French" carried out by the lecturer obtained the following results. The overall average number obtained results of 91.8% with excellent criteria with a score of 228 out of a maximum total of 250. The conclusion of the student results on Android-based interactive multimedia using Adobe Animate CC "Best French" in students of the French Language Education Study Program in the Production écrite avancée course that has been developed is declared feasible and meets the needs with the overall criteria of "Excellent". This means that the learning media developed has increased development and can meet the demands of needs in learning. More fully, the results of the data acquisition are shown in the graph diagram in the following diagram.

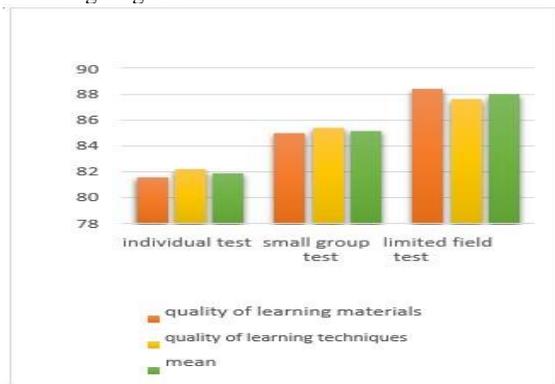


Figure 2. Diagram of The Results of Each Test

The development of the French educational game "Best French" has gone through several stages, namely analysis,

design, development, implementation, and evaluation. The stages of analysis include demand analysis, hardware analysis, and software analysis. This information is used to collect the information necessary to develop the application of the French educational game "Best French". In the evaluation phase, the results of the implementation of the French educational game "Best French" are reviewed so that it can be known the adequacy of the software, advantages, and disadvantages, and suggested applications that are being developed.

Then there is the difference in learning achievement in French speaking and writing skills in students between those taught using the French educational game media "Best French". The results of the study using the t-test on the post-test data showed that there was a difference in learning achievement in French speaking skills in students between those who were taught using the game media mots croisés and those who were taught using textbook media. This is evidenced by the results of data analysis and t-test, it is known that the value of the t-count is greater than the t-table ($t\text{-count} = 5.847 > t\text{-table} = 1.784$). Thus, the discussion in this study succeeded in proving that this hypothesis states that there is a difference in learning achievement in French language skills between those taught using the French educational game "Best French" and using textbook media in early-year students. It can be seen the difference in learning achievement in the form of scores, where the experimental class before getting treatment, has a pretest average score of 70.80 from the total score of 100 assessments. While the control class had a pretest average score of 87.38. and those taught using textbook media. This study shows that there is a significant improvement in student learning achievement. From the results of the study, it can be concluded that this game media can help in making it easier to convey material, and can help improve french acquisition skills.

In addition to causing a sense of joy, this game media can also train students' creativity in learning languages and make students more active, especially being able to increase vocabulary so that they can be applied to speaking skills in simple dialogues related to the themes that have been taught. In contrast to the class students in the control class, they look less active, less excited, and feel bored. The use of appropriate and practical media can be a solution in delivering a material. The ability of teachers to choose good media is very necessary because the use of media can determine the success rate of language learning, especially in the language learning material itself. Based on the results of the study, it can be concluded that the French educational game "Best French" is very good to be applied or applied in language learning as well as making it easier for beginner-level French students or learners to remember vocabulary to be applied in writing and speaking skills. In addition to being fun, this media is also very familiar to the public, so students do not have difficulty in this French educational game "Best French".

4. CONCLUSIONS

Game edukasi Bahasa Prancis "Best French" meliputi pengujian kompeten alat, kompeten materi dan implementasi sebagai berikut: Penilaian kualitas tes disiplin permainan yang diujikan oleh kompeten media tergolong sangat cukup, dengan persentase sangat baik sebesar 96%, penilaian percobaan dari ahli materi telah memperoleh hasil yang baik dengan persentase kecukupan 86%, hasil pelaksanaan terhadap siswa tergolong baik dengan persentase kecukupan

83,83%. Therefore, the French educational game "Best French" can be said to be quite a French learning medium. For further research and development, this application can function together with the database so that users can gain experience in playing score music and interacting with mobile multiplayer, multi-platform servers so that players can establish connections with other players.

5. REFERENCES

- [1] Anshari, M., Alas, Y., Hardaker, G., Jaidin, J. H., Smith, M., & Ahad, A. D. (2016). Smartphone habit and behavior in Brunei: Personalization, gender, and generation gap. *Computers in Human Behavior*, *64*, 719-727.
- [2] Smartphones usage in the classrooms: Learning aid or interference?. *Education and Information Technologies*, *22*(6), 3063-3079.
- [3] Astuti, I. (2019). The Implementation of ADDIE Model in Developing Career Guidance Program in Senior High School. *JETL (Journal Of Education, Teaching and Learning)*, *4*(1), 174-179.
- [4] Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in economic development evidence from aggregate cross-country data. *Journal of Monetary economics*, *34*(2), 143- 173..
- [5] Binyamin, S. S., Rutter, M. J., & Smith, S. (2018). The Influence of Computer Self-Efficacy and Subjective Norms on the Students' Use of Learning Management Systems at King Abdulaziz University. *International Journal of Information and Education Technology*, *8*(10), 693-699.
- [6] H. D. Hutahaean, S. Muhammad Aulia Rahman, and M. D. Mendoza, "Development of interactive learning media in computer network using augmented reality technology," *J. Phys. Conf. Ser.*, vol. 2193, no. 1, 2022, doi: 10.1088/1742-6596/2193/1/012072.
- [7] Blake, M. R., & Morse, C. (2016). Keeping your options open: A review of open source and free technologies for instructional use in higher education. *Reference Services Review*, *44*(3), 375-389.
- [8] Cole, A. W., & Weber, N. L. (2019). *The Use of Emerging Technology Exploration Projects to Guide Instructional Innovation. In Technology Leadership for Innovation in Higher Education*(pp. 165-184).
- [9] Divayana, D. G. H. (2017). Utilization of CSE-UCLA model in evaluating of digital library program based on expert system at Universitas Teknologi Indonesia: A model for evaluating of information technology-based education services. *Journal of Theoretical & Applied Information Technology*, *95*(15).
- [10] H. D. Hutahaean, W. Sumatera, W. Sumatera, and M. Dominique, "Augmented Reality for Mobile-Based Computer Network Learning Interactions," vol. 10, no. 12, pp. 276–278, 2021.
- [11] Dotong, C. I., De Castro, E. L., Dolot, J. A., & Prenda, M. (2016). Barriers for educational technology integration in contemporary classroom environment. *Asia Pacific Journal of Education, Arts and Sciences*, *3*(2), 13-20.

Application of Augmented Reality Technology to Hospitality French Learning

Ria Fuji Destria

French Language Education, Faculty of Language and Art, Universitas Negeri Medan, Medan, North Sumatera, Indonesia

Hesti Fibriasari*

French Language Education, Faculty of Language and Art, Universitas Negeri Medan, Medan, North Sumatera, Indonesia

Zulherman

French Language Education, Faculty of Language and Art, Universitas Negeri Medan, Medan, North Sumatera, Indonesia

Baharuddin

Electrical Engineering Education Departemen, Faculty of Engineering, Universitas Negeri Medan, Medan, North Sumatera, Indonesia

Rizki Fadila Nasution

Indonesian Language and Literature, Universitas Negeri Medan, Medan, North Sumatera, Indonesia

Abstract: The delivery of teaching materials in lectures is one of the parts that determine students' understanding of the material presented, especially when lecture materials are things that demand equipment that supports outdoor activities or requires practicum devices that are not possible to be applied to the room, for example in the Unimed French Language Education study program in semester 6. Students will meet the practicum course in the l'hôtellerie or hospitality course this course requires students to imagine being in a hotel directly with all existing activities with a long enough duration. If this course is delivered only in words and sometimes monotonous delivery bores students so that they are less interested in difficulty in mastering the lecture material. One way that can be done to overcome this is to use visual equipment so that what is conveyed in a visual way makes students interested in the material presented and then brings the imagination that they are in a real hotel so that they live the learning in this hospitality course. However, visual delivery in the room is also a problem when the number of learners is large. For this reason, equipment is needed that can provide information visually and is easy to use or carry that can spur student activities to interact. Media augmented reality is a visual model that can provide new experiences in interacting between real objects and virtual objects that are formed in three-dimensional form, using augmented reality packaged as learning material can help students to understand the teaching material in l'hôtellerie lectures.

Keywords: Media, Augmented Reality, L'Hôtellerie course, French

1. INTRODUCTION

The role of learning media in the delivery of material in education is one of the inseparable parts of the implementation of teaching and learning. Material conversion in the form of symbols, both verbal and non-verbal, is called encoding, and the interpretation of these symbols is called decoding. The decoding process is very dependent on the educator in changing the material presented until it is understandable to the learners". Sometimes using visual media is not necessarily able to provide understanding to students about the material presented, especially subject matter that requires special equipment, in the course l'hôtellerie requires equipment that is not cheap when the material presented requires activities outside the hotel or if done in a hotel can only be done once for learning one semester.

Augmented reality is a visual model of combining the real world with the virtual world in a two-dimensional or three-dimensional form that is projected in a real environment at the same time. Augmented reality or Augmented reality can provide a new experience in terms of interaction between the user and the media to be conveyed. In learning models that require learning media that requires expensive equipment, augmented reality is a solution to overcome this. Students can

understand a concept that is conveyed through interactive activities in augmented reality.

Augmented reality can be implemented into equipment that uses visual media such as computers and communication equipment so that it can be easily used by students and can carry out practicum in virtual form. As well as in explaining how the description of the location of the hotel, the types of rooms, front office activities, and restaurant activities in a hotel in the lecture material l'hôtellerie is certainly more interesting if it is conveyed visually using augmented reality, to save funds and time as well as achieve more support for students. The development of technology that is increasingly advanced, of course, has an effect on various sectors of human life. This development also plays a role in the development of a learning medium. Learning media is becoming more and more interesting and more concise, although it does not detract from the essence of the material. One of the developments of learning media that are currently still new is learning media using Augmented Reality.

2. SIMULATION MODEL

The augmented reality Villa web application is an application design that aims to support promotional media on a villa website. The app is built with the Flair Toolkit library to support rendering on the web and subsequently displaying 3-dimensional objects. The application runs on a hotel brochure, and visitors can scan the marker on the brochure. The use case diagram helps explain the mechanisms that occur on the website. A use case is a diagram that shows the functionality of a system or class and how that system interacts with the outside world and describes the system functionally visible to the user. A clearer mechanism can be seen in Figure 1.

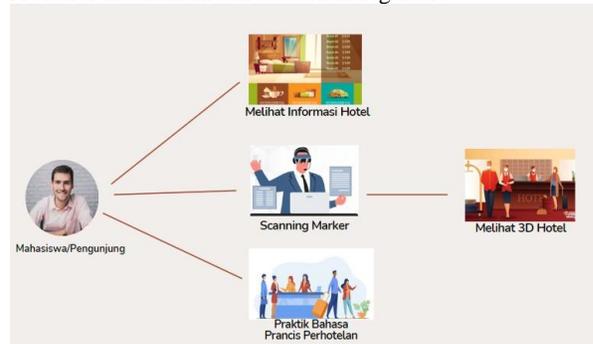


Figure 1. AR Usage Diagram

The flow contained in Figure 1 is an overview of the design of the villa's augmented reality web application system as a whole. Home, Scan Marker, Services, Rooms, Restaurants, swimming pool, and Contact pages, are found in the hotel brochure. Students are presented with information on each page provided. Students are faced with a space to display video from a webcam on a marker scan page. Students can scan the marker on this page by facing the marker on the webcam to display the villa's 3-dimensional object. The interface design is the initial design of the hotel's AR display. This interface design is intended to make it easier to create interfaces from the system. The design made is user-friendly which aims to make users feel interested, comfortable, and easy to use. The design of the AR interface is as follows.

- a. Main Page Interface Design
The main page is a page that appears when visitors enter the website address in the address bar. Visitors can see the website menu, services, activities, photo slides, as well as hotel contact information.
- b. Scan Marker Page Interface Design
The scan marker page is a page that appears when a visitor presses the scan marker button. Visitors can scan the marker using the marker contained in the hotel brochure.

3. RESULT

After analyzing the application overview, the next thing to do is design the application system. What is important to pay attention to in the process of making this application is how to create an application that is user-friendly, namely the user as the user of the application, in this case, especially Universitas Negeri Medan French students can easily understand using the application created.

The flowchart structure serves to define and illustrate the system workflow as well as the basic structure of designing an

augmented reality hotel web application for use in the l'hôtellerie course. The structure can be seen in Figure 2:

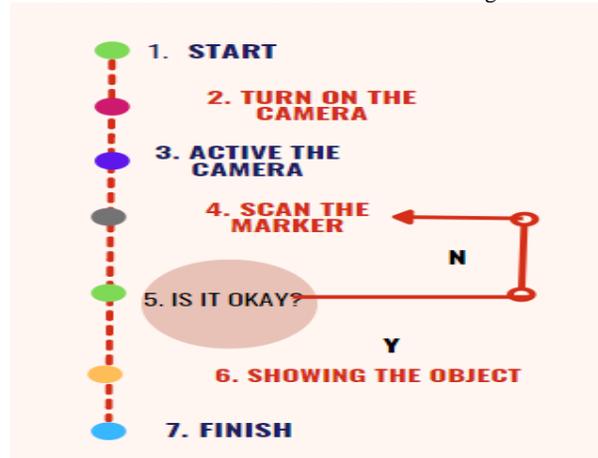


Figure 2. Flowchart Steps AR Usage Augmented Reality App Development

Hospitality intended for learning in l'hôtellerie courses for French students uses the FlarToolkit library as an augmented reality library which is used as a place to store and process 3-dimensional objects and tracking identification on camera devices. The application performs detection through a webcam camera to detect markers, then displays a 3-dimensional object (rendering) of hotel facilities if a recognized marker is found. Figure 2 shows the flow of the application's flowchart, when the camera is active automatically the system scans the marker on the captured image, when the marker is detected then the system displays a 3-dimensional object of the hotel just above the marker.

a. Brochure Design and Manufacture

The brochure that is made serves as a promotional medium as well as a medium for placing markers. Several pages are contained in the brochure, including cover, profile, location, hotel, price, activity, and restaurant. Brochure design created using Adobe Photoshop CS 5. Figure 3 is the result of designing a brochure.



Figure 3. Brochure Design and Manufacture

The last stage is to test applications that have been completed programmatically. Testing is carried out by debugging the application into a smartphone, to determine the success rate of the application when used. The application is tested on how many different types of smartphones. This is done to test the reliability of the application when used in various different types of smartphones trial or performance of the augmented reality villa web application aims to test whether the user can interact with the application, as well as whether the application can display information that is needed and expected. The results of the trials conducted are as follows:

1. The display of the scan marker page is a page that appears when the user presses the scan marker button found on the main menu.
2. The user first presses the allow button in the adobe flash player setting dialog box to activate the webcam contained in the video display space.
3. The next stage of the webcam is directed to the presence of the marker contained in the hotel brochure
4. Displays augmented reality video renderings that display marker detection results in the form of 3-dimensional objects of the hotel.

Application system analysis is the process of analyzing and evaluating a piece of software to test whether the software meets the requirements or not and to determine the difference between the expected results and the actual results. System analysis is carried out by survey research methods, data collection, data presentation, and analysis to manage data. The following describes the aspects of augmented reality villa testing:

1. Aspects of application process suitability, trial to the correctness of the hotel's augmented reality web application process. The test was carried out by looking at the suitability of the output produced by the application by applying it to the marker contained in the brochure. The application is run and then tracked against markers on brochures.

2. Aspects of user interface design, the trial of application appearance, suitability of scan marker feature, ease of use of the application, and the ability of the device to run augmented reality hotel web applications.

b. Calculation and Presentation of Data

Perhitungan dan penyajian data dilakukan untuk mengetahui hasil akhir dari survey yang telah dilakukan. Berikut merupakan perhitungan dan penyajian data hasil survey.

1. Process Conformity Aspects

The results of the assessment of 20 respondents regarding the conformity aspects of the application process can be seen in Table 1.

Table 1. Hotel AR Process Conformance Trial

Statement	Valuation			
	Not Good Enough	Good Enough	Good	Very Good
Suitability of AR display on hotel brochures	0%	7,2%	92,6%	0%
Suitability of AR display on hotel brochures	0%	12,3%	81%	7,6%
Average	0%	9,9%	87,3%	4,3%

2. User Interface Aspects and Features

The results of the assessment of 15 respondents regarding aspects of user interface and features can be seen in Table 2.

Table 2. User Interface and Features Trial

Statement	Valuation			
	Not Good Enough	Cukup Baik	Not Good Enough	Sangat Baik
Conformity of marker scan feature	0%	72,6%	90,6%	0%
Ease using the App	0%	72,6%	71%	60,6%
The application can run well	0%	72,6%	71%	60,6%
Average	0%	72,6%	89,6%	60,6%

The user interface and features aspects obtained the highest average on good answers of 89.6% and the second highest score of 60.6% on excellent answers. Based on this magnitude, it can be interpreted that the user interface and application features are running well, so this augmented reality hotel application is easy to understand and easy to use.

4. CONCLUSIONS

Based on the results of trials and analysis from the Augmented Reality Hotel Application, several things can be concluded, namely the Augmented Reality Hotel Application is able to display 3-dimensional objects of the hotel's interior and exterior and can be a supporting tool for information media. Media augmented reality is a visual model that can provide new experiences in interacting between real objects and virtual objects that are formed in three-dimensional form, using augmented reality packaged as learning material can help students to understand the teaching material in l'hôtellerie lectures.

5. REFERENCES

- [1] I Dewa Gede W. D., I Ketut Gede D. P. & Ni Made Ika M. M. 2015. Aplikasi Augmented Reality Magic Book Pengenalan Binatang untuk Siswa TK. *Jurnal Lontar Komputer*. 6(2). Hlm. 589-596
- [2] E. S. Program *et al.*, “Development of a Web-Based Research and Community Service Information System to Improve Higher Education Services,” *Int. J. Comput. Appl. Technol. Res.*, vol. 11, no. 04, pp. 88–90, 2022, doi: 10.7753/ijcatr1104.1001.
- [3] H. D. Hutahaean, S. Muhammad Aulia Rahman, and M. D. Mendoza, “Development of interactive learning media in computer network using augmented reality technology,” *J. Phys. Conf. Ser.*, vol. 2193, no. 1, 2022, doi: 10.1088/1742-6596/2193/1/012072.
- [4] Ganney, P. S., Pisharody, S., & Claridge, E. (2014). Software Engineering. In *Clinical Engineering* (pp. 133–170). <https://doi.org/10.1016/B978-0-12-396961-3.00009-3>.
- [5] N.R Raajan. et al. 2014. A Review on: Augmented Reality Technologies, System and Applications. *Jurnal Asian Network for Scientific Information*. 14(14).Hlm. 1485-1486.
- [6] H. D. Hutahaean, W. Sumatera, W. Sumatera, and M. Dominique, “Augmented Reality for Mobile-Based Computer Network Learning Interactions,” vol. 10, no. 12, pp. 276–278, 2021.

The Effectiveness of Developing Interactive Learning Media on Learning Basic Concept Material

Charles Fransiscus Ambarita
Economic Education Study
Program
State University of Medan
Medan, Indonesia

Dita Eka Pertiwi Sirait
Business Education Study
Program
State University of Medan
Medan, Indonesia

Dody Feliks Pandimun
Ambarita
Primary School Teacher
Education Study Program
State University of Medan
Medan, Indonesia

Abstract: This study's aim was to determine the interactive learning media effectiveness on the Learning Basic Concept material. The ADDIE Robert Maribe Branch approach is being used in this research and development. Regarding product effectiveness, in the field trial conducted, the t-test result was obtained $t_{count} = 5.09$ while $t_{table} = 1.699$ at significance level of 0.05. This shows that $t_{count} > t_{table}$, then H_0 is rejected and H_a is accepted, so that interactive learning media based Lectora Inspire is effectively used in the learning process.

Keywords: Interactive Learning Media, Learning Basic Concept Material, Effectiveness

1. INTRODUCTION

The 4.0 industrial revolution is a challenge for everyone. Various institutions and industries are experiencing rapidly disruptive technology. Science and information technology developments have a significant impact on many aspects of human existence, including education. In order to develop human potential and generate superior human resources, education is crucial. It can be reviewed in Undang-Undang No. 20 Pasal 3 Tahun 2003 concerning the National Education System, namely that national education functions to develop capabilities and shape the character and civilization of a dignified nation in the context of educating the nation's life and aims to develop the potential of students to become human beings who believe and fear God Almighty, noble, healthy, knowledgeable, capable, creative, independent and become a democratic and responsible citizen [1].

If the goals for education quality can be met and have an effect on raising the standard of human resources, then education quality improvement has been effective. No exception, higher education must also keep enhancing the human resource market competitiveness. Universities must be able to create and provide competency-based education in order to generate graduates who are competent in their respective disciplines as they face the 4.0 industrial revolution. The learning process in education in the period of the fourth industrial revolution must be able to include technology.

Lecturers, who serve as the basis of higher education at universities, must be ready to adapt to the 4.0 industrial revolution by strengthening their expertise since they will be teaching students from the digitally native millennial age. They are familiar with various technologies that are growing rapidly so that they pose challenges for lecturers. Lecturers must continue to learn to improve their competence to face the millennial generation college students. At the 2018 World Economic Forum, Alibaba Group CEO Jack Ma said stated that education is one of the biggest challenges. If don't change the education system, human life can face problems in the future. Education is the major issue at the moment. if don't modify the way or the teaching system then in 30 years it will

be an issue [2]. Therefore, lecturers in the era of the 4.0 industrial revolution need to be proficient in information technology. Technology can assist lecturers in managing materials more efficiently so that the learning process is successful.

One of Indonesia's higher education institutions, State University of Medan is tasked with producing qualified teachers who are competitive graduates. As an important element of State University of Medan, the Economics Education study program contributes to the achievement of the university's purpose. According to the observation made, interactive learning material are required to make the teaching and learning process easier. This problem became more apparent when discussions were held with KDBK lecturers for the same material that college students' mastery of the Learning Basic Concept material was relatively low. The scores of college students on the Mid-Semester Examination in the odd semester of last year show a low level of understanding of the Learning Basic Concept material. Based on the problem and reality above, optimization effort in the form of comprehensive research on interactive learning media on the Learning Basic Concept material is required to solve the problem encountered. This research is critical and must be conducted, so that mastery of the content may be accomplished comprehensively. Based on the description, the researchers are interested in carrying out research and development with the title "THE EFFECTIVENESS OF DEVELOPING INTERACTIVE LEARNING MEDIA ON LEARNING BASIC CONCEPT MATERIAL".

2. METHOD

Research and development methods are being used in this study. The research and development method is a research method used to produce certain product and test the effectiveness of the product [3]. This study intends to provide interactive learning media on Basic Concepts Learning materials which are made systematically and assessed for their effectiveness. ADDIE Robert Maribe Branch approach in Sugiyono is used in this research. Mulyatiningsih suggested that the ADDIE model can be used for various forms of product development in learning activities such as models, learning strategies, learning methods, medias, and teaching

materials [4]. This study lasted 11 months, from January to November 2022, at the Economic Education Study Program, Faculty of Economics, State University of Medan. In order to collect data from representatives of college students enrolled in the Economic Education study program at the Faculty of Economics at State University of Medan during the even semester of the 2022–2023 academic year, the trial participants were chosen at random. Sugiyono stated that data collection techniques are the most strategic steps in research, because the main purpose of research is to obtain data [5]. In this study, tests were used to collect data on college students learning outcomes before and after being taught using interactive learning media based Lectora Inspire. In this paper, only the effectiveness of the product being developed are explained.

3. RESULT AND DISCUSSION

3.1 Result

After the developed product is declared eligible to be tested by material and media experts, it will proceed to the field trial. This field trial was carried out using an experiment method. The researcher first gave a pre-test to all trial college students of the Economic Education Study Program, Faculty of Economics, State University of Medan. Furthermore, researchers conduct learning using the product developed. After that the researcher gave a post-test to all trial college students of the Economic Education Study Program, Faculty of Economics, State University of Medan. The pre-test and post-test scores are as follows:

Table 1. Pre-Test and Post-Test Results

No.	College Students	Pre-Test (X1)	Post-Test (X2)
1	AS	56	80
2	ASTP	56	81
3	ARRN	56	86
4	ARH	29	71
5	ASR	47	83
6	AK	56	80
7	ATA	48	78
8	ASI	43	80
9	ARIS	78	96
10	CKM	46	93
11	CNF	72	84
12	DNK	69	93
13	EGF	36	76
14	ELZ	68	80
15	GS	63	92
16	HFA	54	89
17	HWL	58	91
18	IPA	76	94
19	LP	60	78
20	MAA	52	76
21	MZHF	52	76
22	MAF	48	76
23	MJDP	59	80
24	N	59	84
25	OA	51	81
26	SN	65	80
27	SPEs	52	91
28	SS	72	83
29	WAP	52	76
30	WD	72	92
	Total	1705	2500
	Average	56.83	83.33

Based on table 1, it can be seen that the results of pre-test and post-test show a difference, namely from the result of pre-test before using interactive learning media based Lectora Inspire obtaining an average of 56.83 then the post-test result after using interactive learning media based Lectora Inspire earned a gain of 83.33. So, it can be concluded that there is an increase in college students learning outcomes after using

interactive learning media based Lectora Inspire. However, to obtain more significant result, the researchers will use the t-test calculation.

The t-test was conducted to obtain more significant result and to determine the effectiveness of the product being developed. The calculation of the t-test is carried out with the following steps:

Step 1: Make H_a and H_o in sentence form

H_a = there is a significant difference between before and after using learning media based Lectora Inspire.

H_o = there is no significant difference between before and after using learning media based Lectora Inspire.

Step 2: Finding t_{count}

Step 3: Determine the t-test criteria

If $t_{count} > t_{table}$, then the result is significant, meaning that H_a is accepted.

If $t_{count} < t_{table}$, then the result is non-significant, meaning that H_a is rejected.

Step 4: Determine the statistical results on the pre-test and post-test with the t-test formula

After calculating using the t-test formula, the statistical results are 5.09

Step 5: Comparing t_{count} and t_{table}

t_{hitung} is 5.09

t_{table} is 1.699

Step 6: Conclusion

The calculation result show that t_{count} is greater than t_{table} , so H_o is rejected and H_a is accepted. It means that there is a significant difference between college students scores before and after using interactive learning media based Lectora Inspire. Based on the result, it can be concluded that there is a significant increase in learning outcomes between before and after using interactive learning media based Lectora Inspire. In this case, interactive learning media based Lectora Inspire is effectively used in the learning process. In this way, interactive learning media based Lectora Inspire is able to help the learning activities take place in achieving learning objectives and plays an important role in encouraging the effectiveness of learning activities.

3.2 Discussion

The procedure in this research and development adapts from the summary of Instructional Design with the ADDIE Robert Maribe Branch approach in Sugiyono which consists of five stages, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation and 5) Evaluation [6]. The results of pre-test and post-test show a difference, namely from the result of pre-test before using interactive learning media based Lectora Inspire obtaining an average of 56.83 then the post-test result after using interactive learning media based Lectora Inspire earned a gain of 83.33 and the result of t-test calculation show that t_{count} (5.09) is greater than t_{table} (1.699). Based on the results, the research that has been done proves that the development of interactive learning media based on Lectora Inspire is effectively used as a learning media by college students.

4. CONCLUSION

Regarding product effectiveness, in the field trial conducted, the t-test result was obtained $t_{count} = 5.09$ while $t_{table} = 1.699$ at significance level of 0.05. This shows that $t_{count} > t_{table}$, then H_o is rejected and H_a is accepted, so that interactive learning

media based Lectora Inspire is effectively used in the learning process.

5. ACKNOWLEDGMENT

Special thanks to Prof. Dr. Baharuddin, M.Pd. for the funds that have been given through the Community Service Institute of State University of Medan, may you always be blessed by God Almighty in your work, health, long life and all elements of life.

6. REFERENCES

- [1] Departemen Pendidikan Nasional RI. 2003. *Undang-Undang No. 20 Tahun 2003 Tentang Sistem Pendidikan Nasional*. Bandung: Fokusmedia.
- [2] Melani, A. (25 Januari 2018). Jack Ma: Ubah Pendidikan agar Bersaing dengan Robot. Diambil pada tanggal 15 Mei 2022 dari <https://www.liputan6.com/bisnis/read/3238241/jack-ma-ubah-pendidikan-agar-bersaing-dengan-robot>
- [3] Sugiyono. 2013. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- [4] Mulyatiningsih, Endang. 2014. *Metode Penelitian Terapan Bidang Pendidikan*. Badung: Alfabeta.
- [5] Sugiyono. 2015. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- [6] Sugiyono. 2017. *Metode Penelitian dan Pengembangan*. Bandung: Alfabeta.

The Practicality of Developing Module as a Learning Media in Communication Psychology Course

Nasrun
Guidance and Counseling
Department
State University of Medan
Medan, Indonesia

Edizal Hatmi
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Dody Feliks Pandimun
Ambarita
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Abstract: This study aims to determine the practicality of module as learning media on Communication Psychology course at Guidance and Counseling department, State University of Medan. This study is Research and Development using the ADDIE model. The data collection techniques used are observation, validation sheets and questionnaires. The practicality analysis results show that one learning practitioner gives an average score of 55 where the average value is in the range $X > 47.6$ which is included in the very practical category. Furthermore, 25 students gave an average score of 54.8 where the average score is in the range $X > 47.6$ which is also included in the very practical category. It means that the practicality of this module is in the very practical category.

Keywords: Practicality, Module As Learning Media, Communication Psychology Course

1. INTRODUCTION

Education is the most important indicator in a country. Education in Undang-Undang Nomor 20 Tahun 2003 is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills they need, society, nation and state [1]. Therefore, the efforts that can be made to achieve the definition of education can be pursued through a good and planned educational process.

Furthermore, the education process according to Permendikbud Nomor 59 tahun 2014 is a process that provides opportunities for students to develop their potential in rotational thinking skills and academic brilliance by giving meaning to what they see, hear, read, and learn to apply in everyday life [2]. Meanwhile, according to Undang-Undang No. 2 Tahun 1989 concerning the National Education System, the national education system functions to develop capabilities and improve the quality of life and human dignity of Indonesia in the context of efforts to realize national goals [3].

In Pasal 4 of Undang-Undang No. 12 Tahun 2012 concerning Higher Education states that higher education functions:

- a. develop abilities and form character and dignified national civilization in order to educate the life of the nation;
- b. developing innovative, responsive, creative, skilled, competitive, and cooperative academics through the implementation of the tri dharma and;
- c. develop science and technology by paying attention to the value of the humanities [4].

Furthermore, the Pasal 5 states that higher education aims:

- a. developing the potential of students to become human beings who believe in and fear God Almighty and have noble character, healthy, knowledgeable, capable, creative, independent, skilled, competent and cultured for the benefit of the nation;

- b. produce graduates who master the branch of Science and/or Technology to fulfill national interests and increase the nation's competitiveness;
- c. producing Science and Technology through Research that pays attention to and implements Humanities values so that they are beneficial for the progress of the nation, as well as the progress of civilization and the welfare of mankind; and
- d. the realization of Community Service based on reasoning and research works that are useful in promoting general welfare and educating the nation's life [5].

To realize these, State University of Medan as one of the state universities in Indonesia has a responsibility to produce graduates who are competitive in the form of qualified teaching staff. The Guidance and Counseling department as an integral part of State University of Medan has contributed to the success of State University of Medan's mission to respond to challenges, opportunities, community demands, and prepare professional and competitive teacher candidates.

However, based on the results of observations on the Communication Psychology course that has been taking place in the Guidance and Counseling department, it was found that the low mastery of college students in understanding the Communication Psychology course material was due to a lack of literature or references related to the Communication Psychology course material. This is contrary to the opinion of Usman and Asnawi which says that if a subject requires more than one infrastructure, the teacher can use the infrastructure as much as possible according to needs, this is used so that it can benefit and facilitate learning process and can stimulate students in learning [6]. As for the literature that can be used according to the Surat Keputusan Menteri Pendidikan Nasional Republik Indonesia No. 053/U/2001 concerning educational facilities including:

- a. space includes education room, administration room, and supporting room,
- b. educational tools and media, and

- c. books include basic textbooks (teachers and students), complementary textbooks, reading books and source books (references) [7].

Therefore, it is necessary to procure learning media, especially module that can improve student mastery of the subject matter of Communication Psychology that can be done by lecturers by developing module as learning media. Majid defines the module as part of the types of teaching materials used in assisting the learning process for students [8]. Then Gafur, module is essentially a message delivery planning activity [9]. Meanwhile, Maulinda said that teaching modules are very important in the learning process for teachers and students. Indeed, teachers will have difficulty upgrading teaching effectiveness if they are not paired with a complete teaching module [10]. Furthermore, Budiono and Hadi, preparation of learning modules aim to guide students to actively learn, experience learning experiences for themselves, one of which is through the exercises provided in the module [11].

Based on the description above, researchers need to know the practicality of the module as a learning media developed in the Communication Psychology course at the Guidance and Counseling department, State University of Medan. Therefore, research was carried out entitled "The Practicality Of Developing Module As A Learning Media In Communication Psychology Course".

2. METHOD

The method applied in this study is included in the type of research and development. Sugiyono says that the main purpose of this research and development method is to produce certain product and test the effectiveness of the product [12]. Then Samsu said that this research and development research is essentially carried out to develop previous research products in a sustainable manner, so that there are ideal changes and developments as expected [13]. Furthermore, Yuliana, research and development is a research method used to produce new product designs, test the effectiveness of existing products and develop and create new products [14].

The subject of this research consists of several elements as follows:

- a. Material expert
This research requires a material expert as a validator or a giver of suggestions or comments on the material.
- b. Media expert
This research requires a material expert as a validator or a giver of suggestions or comments about the media.
- c. Trial subjects
This research requires a learner practitioner and semester III college students in Guidance and Counseling department at State University of Medan for the 2022/2023 academic year as giver of suggestions or comments about the media. The selection of test subjects was carried out randomly with the hope that they could become a source of data from representatives of learner practitioner and

semester III college students in Guidance and Counseling department at State University of Medan for the 2022/2023 academic year.

This research will be carried out in the Guidance and Counseling department, State University of Medan for 11 months, starting from January to November 2022. Data collection techniques in this study were observation, validation sheets and questionnaires. Observation will be made to obtain information on problems related to learning media so that the product to be developed is in accordance with the results of the observation. Meanwhile, questionnaires were used to collect learner practitioner and college students assessments data regarding the product being developed.

This development research uses descriptive analysis techniques to analyze data by describing the data that has been collected from the results of development, learner practitioner and college students responses to obtain the practicality of the developed module. The development model used in this study is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. Baharuddin (2012) in Izzati (2015) suggests that one of the guidelines for validating and developing a product is the ADDIE model. This paper only explains the practicality of the product being developed because the feasibility of the product being developed has been published in a previous article.

3. RESULTS AND DISCUSSIONS

3.1 Results

The practicality data of module was obtained through a practicality questionnaires. This stage involved 1 learner practitioner and 25 college students. The practicality assessment are as follows:

Table 1. Practicality Assessment Questionnaire From Learner Practitioner

Respondent	Respondent Assessment														Total	Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Bapak Harpen Silitonga, S.Pd., M.Hum.	4	3	4	4	4	4	4	4	4	4	4	4	4	4	55	55

Based on the table, it can be seen that at the module practicality test stage, 14 response statements were used regarding the practicality of the module and one learning practitioner as a respondent who gave a response about the practicality of the module with an average value of 55.

Table 2. Practicality Assessment Questionnaire Analysis From Learner Practitioner

No.	Range	Frequency	%	Category
1.	$X > 47.6$	1	100	Very practical
2.	$39.2 > X \leq 47.6$	0	0	Practical
3.	$30.8 > X \leq 39.2$	0	0	Quite practical
4.	$22.4 > X \leq 30.8$	0	0	Less practical
5.	$X > 22.4$	0	0	Not practical

Based on the table, it can be seen that the average practicality value of the module from one learning practitioner as a respondent is in the range $X > 47.6$ where this value is in the very practical category.

Table 3. Practicality Assessment Questionnaire From College Students

Respondents	Respondents Assessments														Total	Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
MSOD	4	3	4	4	4	4	3	4	4	4	4	4	3	3	52	54.8
MM	4	4	4	3	4	4	4	4	4	4	4	4	4	4	55	
LMT	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
WKD	4	4	4	4	3	4	4	4	4	4	4	4	4	4	55	
LP	4	4	4	4	3	4	4	4	4	4	4	3	4	4	54	
MTS	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
NRBM	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
LRM	4	4	4	4	4	3	3	4	4	4	4	4	4	4	54	
YDS	4	4	4	4	3	3	4	4	4	4	3	4	4	4	53	
NG	3	4	4	3	3	4	4	4	4	4	4	4	4	4	53	
MES	3	3	4	4	4	4	4	4	4	4	4	4	4	4	54	
MP	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
MAERM	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
MONP	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
NAL	3	4	4	4	4	4	4	4	4	4	3	4	4	4	54	
LRS	4	4	4	4	4	4	4	4	4	4	3	4	4	4	55	
LK	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
MLM	4	4	4	4	4	4	4	3	4	4	4	4	4	4	54	
LM	4	3	4	4	4	4	4	4	4	4	4	4	4	3	54	
LHR	4	4	4	4	4	4	4	4	4	4	4	4	4	3	55	
LAPA	4	4	4	4	4	4	4	3	4	4	4	4	4	4	55	
MWS	4	3	4	4	4	4	4	4	4	4	4	4	4	4	55	
MKS	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	
MCAN	4	4	4	4	4	4	4	3	4	4	4	4	4	3	54	
MPS	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56	

Based on the table, it can be seen that at the module practicality test stage, 14 response statements were used regarding the practicality of the module and 25 college students as respondents who gave responses about the practicality of the module with an average value of 54.8

Table 4. Practicality Assessment Questionnaire Analysis From College Students

No.	Range	Frequency	%	Category
1.	$X > 47,6$	25	100	Very practical
2.	$39,2 > X \leq 47,6$	0	0	Practical
3.	$30,8 > X \leq 39,2$	0	0	Quite practical
4.	$22,4 > X \leq 30,2$	0	0	Less practical
5.	$X > 22,4$	0	0	Not practical

Based on the table, it can be seen that the average practicality value of the module from 25 college students as respondents is in the range $X > 47.6$ where this value is in the very practical category.

3.2 Discussions

At the practicality test stage, 14 response statements were used regarding the practicality of the module. One learning practitioner as a respondent who gave a response about the practicality of the module with an average value of 55. The average is in the range $X > 47.6$ where this value is in the very practical category. Meanwhile, 25 college students as respondents gave feedback on the practicality of the module with an average score of 54.8 where the average score is in the range $X > 47.6$ which is included in the very practical category.

4. CONCLUSIONS

This research and development uses several stages, namely analysis, design, development, implementation, and evaluation. This paper only describes the practicality of the product being developed because the feasibility of the product being developed has been published in a previous article. Regarding practicality, the practicality of this module is in the very practical category because one learning practitioner gives

an average score of 55 where the average value is in the range $X > 47.6$ which is included in the very practical category. Furthermore, 25 students gave an average score of 54.8 where the average score is in the range $X > 47.6$ which is also included in the very practical category.

5. ACKNOWLEDGMENT

Special thanks to Prof. Dr. Baharuddin, M.Pd. for the funds that have been given through the Community Service Institute of State University of Medan, may you always be blessed by God Almighty in your work, health, long life and all elements of life.

6. REFERENCES

- <https://peraturan.bpk.go.id/Home/Details/43920/uu-no-20-tahun-2003>
- <https://peraturanpedia.id/peraturan-menteri-pendidikan-dan-kebudayaan-nomor-59-tahun-2014/>
- <https://peraturan.bpk.go.id/Home/Details/46794/uu-no-2-tahun-1989>
- <http://unnes.ac.id/wp-content/uploads/uu-12-2012.pdf>
- Asnawir dan Usman, B. M. 2022. *Media Pembelajaran*, Jakarta Selatan: Ciputat Pers.
- <https://luk.staff.ugm.ac.id/atur/bsnp/Kepmendiknas129a-U-2004StandarPelayananMinimal.pdf>
- Majid, Abdul. 2013. *Perencanaan Pembelajaran (Mengembangkan Standar Kompetensi Guru)*. Bandung: PT Remaja Rosdakarya.
- Gafur, A. 2010. Konsep, prinsip, dan prosedur pengembangan modul sebagai bahan ajar. *Jurnal Civics: Media Kajian Kewarganegaraan*, 7(1).
- Maulinda, U. 2022. Pengembangan Modul Ajar Berbasis Kurikulum Merdeka. *Tarbiawi: Jurnal Pemikiran dan Pendidikan Islam*, 5(2), 130-138.
- Budiono, E., & Susanto, Hadi. 2006. Penyusunan Dan Penggunaan Modul Pembelajaran Berdasar Kurikulum Berbasis Kompetensi Sub Pokok Bahasan Analisa Kuantitatif Untuk Soal-Soal Dinamika Sederhana Pada Kelas X Semester I SMA. *Jurnal Pendidikan Fisika Indonesia*, 4(2).
- Samsu, S. A. (2017). *M. Pd. I* (Doctoral dissertation, Ph. D. 2017. Metode Penelitian: Teori dan Aplikasi Penelitian Kualitatif, Kuantitatif, Mixed Methods, Serta Research & Development. Jambi. Pusat Studi Agama dan Kemasyarakatan).
- Yuliani, W., & Banjarnahor, N. 2021. Metode Penelitian Pengembangan (RnD) Dalam Bimbingan Dan Konseling. *Quanta*, 5(3), 111-118.
- Izzati, N. 2015. Pengembangan Modul Pembelajaran Matematika Bermuatan Emotion Quotient Pada Pokok Bahasan Himpunan. *Eduma: Mathematics Education Learning and Teaching*, 4(2).

The Effectiveness of Developing E-Book Learning Media in Class Management Course

Laurensia Masri Perangin
Angin
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Andri Kristianto Sitanggang
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Dody Feliks Pandimun
Ambarita
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Edizal Hatmi
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Charles Fransiscus Ambarita
Economic Education Study
Program
State University of Medan
Medan, Indonesia

Abstract: The purpose of this study is to know the increase of the college students' cognitive learning outcomes who use e-book learning media developed in the Class Management course in the Primary School Teacher Education department, Faculty of Science Education, State University of Medan. This research type is Research and Development with the ADDIE model, namely analysis, design, development, implementation and evaluation. The instruments used for data collection are tests. The results of the increase of the college students' cognitive learning outcomes analysis show that the initial average score is 85.3 while the final average score is 89.8. When viewed from the gain score, obtained a gain score of 0.307 which is classified as the medium category.

Keywords: E-Book Learning Media, Class Management Course, College Students' Cognitive Learning Outcomes

1. INTRODUCTION

Indonesian society is currently faced with the progress and development of education which is a factor in the success of a nation. Education is one of the important components in human life. Education is necessary to gain balance and perfection in the development of individuals as well as society. According to Ki Hajar Dewantara in Nurkholis defines education as an effort to advance children's ethics, mind and physique, in order to advance the perfection of life, namely living and reviving children in harmony with nature and society [1].

Different opinions expressed by Peraturan Pemerintah No. 60 Tahun 1999, in Pasal 2 for the purposes of national education, namely: (1) prepare students to become members of society who have academic and/ or professional abilities who can apply, develop and/ or enrich the characteristics of science, technology and/ or art, (2) develop and disseminate science, technology and/ or art and strive for their use to improve the standard of life of the community and enrich national culture [2]. Therefore, education has a very important role to ensure the development and continuity of the nation's life. Education is an effort process in forming intelligent and skilled humans, realizing quality and creative human resources to be able to compete in the face of scientific advances.

Based on the result of observation carried out in the Class Management course which has been taught in the department of Primary School Teacher Education State University of Medan, it was found that the Class Management course was dominated by power point learning media. According to Mardi et al. in Ardiansah & Miftakhi said that power point is one of

the application programs from Microsoft that can be used to make presentations, both for conducting a meeting and planning other activities including being used as a learning medium in schools. Thus, when learning is dominated by power point learning media that is less interesting, it causes students to feel bored and less enthusiastic when learning takes place so that the learning process does not run effectively and also the learning objectives are not achieved optimally. The factors that cause power point learning media are less attractive are as follows: (1) too much writing on each slide, (2) lack of visual content such as images, videos, and diagrams, and (3) using strange fonts or too small so that it is difficult to read [3].

Education consists of several educational components that have a contribution to the quality of education in the future producing quality graduates. According to Noeng Muhajir in Supendi revealed that the components of education consist of: (1) objectives, (2) subject educators, (3) educators, (4) environment [4]. Then, according to the Undang-Undang Republik Indonesia No. 14 Tahun 2005 Pasal 1 concerning Teachers and Lecturers, that lecturers are professional educators and scientists with the main task of transforming, developing, and disseminating science, technology, and art through education, research, and community service [5].

To realize an interesting and effective learning process, lecturers are an important part of the implementation of education that must have high creativity. The era of the Industrial Revolution 4.0 is marked by the rapid development of science and technology. Technology has a very important role to play. College students who learn through the digital native process tend to be more interested in learning using

learning media or technology-based teaching materials that can be accessed through digital devices such as smartphones. This is what makes lecturers must be able to use technology in developing learning media or innovative teaching materials.

One of the optimization efforts that can be done by lecturers is by procuring innovative, interesting, and informative e-book learning media. According to Istikomah, et al., e-book learning media is an electronic learning media created to make it easier for students to receive learning resources. A student is able to learn practically with his/her e-book, the nature of e-books can be accessed on mobile phones and other electronic devices. E-books are arranged with visual and audio media so that they do not cause saturation in students in learning [6].

Based on the description above and to overcome problems that occur in the field. Researchers are interested in conducting a study entitled "THE EFFECTIVENESS OF DEVELOPING E-BOOK LEARNING MEDIA IN CLASS MANAGEMENT COURSE". So, the formulation of the problem in this study is how is the increase of the college students' cognitive learning outcomes who use e-book learning media developed in the Class Management course in the Primary School Teacher Education department? Meanwhile, the purpose of the study is to find out the increase of the college students' cognitive learning outcomes who use e-book learning media developed in the Class Management course in the Primary School Teacher Education department. Thus, this research is expected to have a contribution to the development of science and can enrich science, especially those related to learning media with e-book learning media that are able to trigger a fun and effective learning process.

2. METHOD

This research is a type of research and development. According to Sugiono in Wanto, et al., the definition of Research and Development (R&D) is often interpreted as a process or steps to develop a new product or improve an existing product [7]. Furthermore, according to Effendi & Hendriyani in Wanto, et al., research on model development with interactive media can also be done online. One type of research that can be a link or breaker of the gap between basic research and applied research is research and development. Research and Development is a type of research that aims to produce a certain product and test the quality of the product [8].

This research and development uses descriptive analysis techniques. Descriptive analysis techniques are carried out to analyze data by describing the data that has been collected from the results of development. This research will be carried out in the department of Primary School Teacher Education State University of Medan for 11 months, starting from January to November 2022. The product that will be produced in this study is an e-book learning media in the Class Management course in the department of Primary School Teacher Education State University of Medan. While there are several elements of research subject, such as:

- a. Material expert
This research requires a material expert as a validator or giver of advice or comments regarding aspects of content and learning.
- b. Media expert
Media expert has the right to validate *e-books* developed in terms of appearance, media elements and grammar.
- c. Test subject
The selection of the subject will be carried out

randomly with the hope that it can become a source of data from representatives of the department of Primary School Teacher Education State University of Medan college students in semester V of the 2022/2023 academic year.

The data collection techniques in this study are observation and test. Observation will be carried out to find out the character of the college students and the technology used by the college students so that the product to be developed is in accordance with the result of the observation. Tests are used to collect data about the increase of the college students' cognitive learning outcomes before and after participating in learning using e-book learning media. The development model used in this study is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. This paper only explains the effectiveness of the product being developed.

3. RESULT AND DISCUSSION

3.1 Result

This stage is a field trial. The trial was carried out in learning using e-book learning media for the Primary School Teacher Education department college students in class E 2022. The data from the results of this field trial were used to determine the increase in college student cognitive learning outcomes. The results of the pre-test and post-test as well as the increase in college students' cognitive learning outcomes are presented in the following table.

Table 1. Pre-Test Result

Subject	Question Item															Correct Answer	Score
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	12	80
2	1	1	1	1	1	1	1	1	1	1	0	1	1	0	13	86.7	
3	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
4	1	1	1	1	0	1	1	0	1	1	1	1	1	1	13	86.7	
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100	
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100	
7	1	0	1	1	1	0	1	1	1	1	1	1	1	1	13	86.7	
8	1	1	1	1	1	1	1	1	1	1	1	0	1	1	14	93.3	
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100	
10															0	0	
11	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
12	0	1	1	1	1	1	1	1	0	1	1	1	1	1	13	86.7	
13	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
14	1	1	1	1	1	1	1	1	1	1	0	1	1	0	13	86.7	
15	1	1	1	1	1	0	1	1	0	1	1	1	1	1	13	86.7	
16	0	1	1	1	1	1	1	1	1	0	1	1	0	1	12	80	
17	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
18	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100	
20	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
21	0	1	1	1	1	1	1	1	1	1	0	0	1	1	12	80	
22	1	0	1	1	1	1	1	1	1	1	1	1	1	0	13	86.7	
23	1	0	0	0	1	1	1	0	1	0	0	1	0	0	6	40	
24	1	1	1	1	1	0	0	1	1	1	1	1	1	1	13	86.7	
25	0	1	1	1	1	1	1	1	1	1	0	1	1	0	12	80	
26	1	1	1	1	1	1	1	1	1	1	1	0	1	0	13	86.7	
27	1	1	1	1	1	0	0	1	0	1	1	1	1	1	12	80	
28	0	1	1	1	0	1	1	1	1	1	0	1	1	0	11	73.3	
29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100	
30	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
31	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
32	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
33	1	1	1	1	1	1	1	1	0	1	1	1	1	0	13	86.7	
34	0	1	1	1	1	1	1	1	0	1	1	1	1	1	13	86.7	

Based on the table, it can be seen that in the pre-test used 14 questions and 34 college students as subjects who answered the questions.

Table 2. Post-Test Result For Questions A

Subject	Question Item															Correct Answer	Score
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
2	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93,3
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100,0
5	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93,3
8	1	1	0	1	1	1	1	1	0	1	0	1	0	1	1	11	73,3
9	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93,3
10																0	0
11	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	12	80,0
13	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93,3
15	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93,3
16	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93,3
20	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93,3
21	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	13	86,7
23	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	12	80,0
24	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	13	86,7
27	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	12	80,0
32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100,0
33	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	13	86,7

Based on the table, it can be seen that in the post-test for question A used 14 questions and 17 college students as subjects who answered the questions.

Table 3. Post-Test Result For Questions B

Subject	Question Item															Correct Answer	Score	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	13	86,7	
4	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	12	80,0
6	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	14	93,3	
7	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	86,7	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100,0	
14	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	13	86,7	
17	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93,3	
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100,0	
19	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93,3	
22	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	12	80,0	
25	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	86,7	
26	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	13	86,7	
1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	13	86,7	
4	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	12	80,0	
6	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93,3	
7	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	86,7	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100,0	

Based on the table, it can be seen that in the post-test for question B used 14 questions and 17 college students as subjects who answered the questions.

Table 4. Gain Analysis Of College Students' Cognitive Learning

Subyek	Total Pre-test Skor	Total Post-test Skor	Sid Gain
1	80	86,7	0,3350
2	86,7	93,3	0,4962
3	93,3	100	1,0000
4	86,7	80	-0,5038
5	100	93,3	0,0000
6	100	93,3	0,0000
7	86,7	86,7	0,0000
8	93,3	73,3	-2,9851
9	100	93,3	0,0000
10			0,0000
11	93,3	80	-1,9851
12	86,7	100	1,0000
13	93,3	93,3	0,0000
14	86,7	86,7	0,0000
15	86,7	93,3	0,4962
16	80	93,3	0,6650
17	93,3	93,3	0,0000
18	93,3	100	1,0000
19	100	93,3	0,0000
20	93,3	93,3	0,0000
21	80	86,7	0,3350
22	86,7	80	-0,5038
23	40	80	0,6667
24	86,7	86,7	0,0000
25	80	86,7	0,3350
26	86,7	86,7	0,0000
27	80	80	0,0000
28	73,3	80	0,2509
29	100	93,3	-1,0000
30	93,3	93,3	0,0000
31	93,3	93,3	0,0000
32	93,3	100	1,0000
33	86,7	86,7	0,0000
34	86,7	100	1,0000
Total Score	2900	3053,3	0,307
Score Average	85,3	89,8	0,306
Lowest Score	0	0	
Highest Score	100	100	
Gain Category			Medium

Based on the table, it can be seen that the initial average score is 85.3 while the final average score is 89.8. When viewed from the gain score, obtained a gain score of 0.307 which is classified as the medium category. This shows that the use of e-book learning media based Kvisoft Flipbook Maker application can improve college students cognitive learning outcomes.

3.2 Discussion

This research and development uses in the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The results of the pre-test and post-test as well as the increase in college students' cognitive learning outcomes show that the initial average score is 85.3 while the final average score is 89.8. When viewed from the gain score, a gain is 0.307 which is classified as the medium category. Based on the results, the research that has been done proves that the development of e-book learning media based Kvisoft Flipbook Maker application can improve college students cognitive learning outcomes.

4. CONCLUSION

Regarding product effectiveness, the initial average score is 85.3 while the final average score is 89.8. When viewed from the gain score, a gain is obtained with an average = 0.307 which is classified as the medium category.

5. ACKNOWLEDGMENT

Special thanks to Prof. Dr. Baharuddin, M.Pd. for the funds that have been given through the Community Service Institute of State University of Medan, may you always be blessed by God Almighty in your work, health, long life and all elements of life.

6. REFERENCES

- [1] Nurkholis. 2013. Pendidikan dalam upaya memajukan teknologi. *Jurnal Kependidikan*, 1 (1): 24-44.
- [2] Peraturan Pemerintah RI No. 60 Tahun 1999 tentang Pendidikan Tinggi.
- [3] Ardiansah, F., & Miftakhi, D. R. 2019. Pelatihan Pembuatan Media Pembelajaran Interaktif Berbasis Powerpoint Bagi Tenaga Pendidik Paud Himpaudi Kecamatan Gabek Kota Pangkalpinang. *Jurnal universitas bangka belitung*, 2 (2): 16-24.
- [4] Supendi, P. 2016. Variasi (Format) Sistem Pendidikan di Indonesia. *Almufida*, 1 (1): 159-181.
- [5] Undang-Undang Republik Indonesia Nomor 14 Tahun 2005 Tentang Guru Dan Dosen.
- [6] Istikomah, U., Mahrawi, & Ratnasari, D. 2021. Pengembangan Media Pembelajaran E-Book Berbasis Problem Solving Pada Materi Sistem Pencernaan Manusia. *Jurnal Pendidikan, Sains Sosial dan Agama*, 7 (1): 25-30.
- [7] Wanto, S., Okilanda, A., Arisman, Lanos, M. E., Putra, D. D., Lestari, H., . . . Oktariyana. 2020. Kupas Tuntas Penelitian Pengembangan Model Borg & Gall. *Jurnal PKM Ilmu Kependidikan*, 3 (1): 46-55.

A Comparative Analysis of Advanced Ensemble Models in Cervical Cancer Prediction

Rebecca Adhiambo Okaka
Jomo Kenyatta University of Agriculture and Technology
Nairobi, Kenya

Abstract: There are no symptoms in the early stages of cervical cancer, detection can only be done through regular Papanicolaou (Pap) and Human papillomavirus (HPV) tests. However, most women are not aware of these tests, if not, shy away from taking these tests, this has led to late cervical cancer diagnosis, and now, cervical cancer is one of the most common causes of cancer deaths among women. Successful cervical cancer treatment can be improved by early diagnosis, which can be achieved by analysing potential risk factors. This paper presents the performance of two advanced ensemble models; Bagging Classifier and Adaptive Boosting (AdaBoost) Classifier in predicting cervical cancer diagnosis based on documented cancer risk factors and target variables. The models were evaluated using accuracy, sensitivity and specificity metrics. Experiments done using the Cervical Cancer Risk Factors dataset found in the University of California at Irvine (UCI) repository shows that both models achieved good accuracy levels and can thus be used in early cervical cancer detection to avoid late diagnosis that has led to massive loss of lives.

Keywords — adaboost classifier; bagging classifier; biopsy; cervical cancer; cytology; hinselmann; schiller

1. INTRODUCTION

Recently, cancer was declared a national disaster in Kenya. Cervical cancer is the second cause of cancer deaths in women after the breast cancer in Kenya, and the fourth most frequent cancer in women in the whole world [1]. Cervical cancer arises from abnormal growth of cervical cells, the cancer can spread from the cervix to other parts of the body like the lungs, liver and bladder. Cervical cancer grows slowly, and has no symptoms in the early stages, even though regular Pap test and HPV test can help detect cervical cancer early, many women feel ashamed of going for the tests and seeking early treatment. Its symptoms such as pelvic pain, abnormal vaginal bleeding and discharge and kidney failure appear in late stages. HPV, a common sexually transmitted infection (STI), is the leading cause of cervical cancer [2], other factors that may lead to cervical cancer include; prolonged use of contraceptives, cigarette smoking and multiple pregnancies.

There are opportunities to improve cervical cancer diagnosis, using Artificial Intelligence (AI) and machine learning approaches. Unassisted medical practitioner is likely to make wrong diagnosis, because they are exposed to imperfect human memory, and varying disease presentation [3], besides, machine learning models can be used to assist medical practitioners in disease diagnosis [4]. At the moment, most computer aided medical diagnosis systems use medical images and frequency signals to assist doctors interpret disease diagnosis, there is need to create systems that could also predict disease diagnosis based on its documented risk factors, to enable early diagnosis and treatment.

Ensemble models, also called multiple classifier models combine several machine learning algorithms to improve their predictive power, they have proven to be very effective and extremely versatile; can be used in a wide variety of problem domains and real world applications [5]. They were

originally developed to reduce variance, bias and improve accuracy in automated systems, but today they have become very successful in addressing a variety of machine learning problems. There are two categories of ensemble models; simple ensemble models and advanced ensemble models. Simple ensemble models use, max voting, averaging and weighted average techniques, advanced ensemble models use, stacking, blending, bagging and boosting techniques. In our study, we use two advanced ensemble algorithms; bagging algorithms and boosting algorithms to predict cervical cancer diagnosis, based on documented risk factors and four cervical cancer indicators tests.

The rest of the paper is organized as follows; related work is discussed in section II, methodology is discussed in section III. Experiments, which includes the dataset used, experimental setup, metrics, results and discussions in section IV, then finally, conclusion and future work in section V and VI.

2. RELATED WORK

Machine learning algorithms provide several tools for smart data analysis [6], with the recent digital revolution, many modern hospitals are now equipped with means for data capture, storage and sharing. Decision trees [7] have been used diagnosing cervical cancer, from experiments, a decision tree achieved accuracies of 92.54%, 92.80%, 94.41% and 90.44% for Biopsy, Cytology, Hinselmann, and Schiller tests respectively. Multilayer Perceptron (MLP), Bayes Net and k-Nearest Neighbour have also been used [8] to correctly classify cervical cancer instances, experiments showed that, Bayes Net achieved the highest classification accuracy, by classifying 97.26% instances correctly, followed by both k-Nearest Neighbour and MLP at 95.89%. The effectiveness of Iterative Dichotomous (ID3), C4.5 and Naïve Bayes in predicting cervical cancer were analysed [9], the results from the test set of each model was averaged, Naïve Bayes got the highest accuracy score of 81%, followed by C4.5 at 72%, then ID3 at 69%. Medical diagnosis is sensitive, therefore apart from accuracy analysis, it is also important to get from a model how often it predicts a disease when the patient actually has the disease, and how often it predicts no disease when a person actually does not

have the disease. From existing literature, many models including the ones discussed in this section, only present their accuracy levels or scores but fail to present their sensitivity and specificity levels.

Many other studies have explored different methods to predict cervical cancer, data based approaches such as support vector machines (SVM), linear regression (LR), principal component analysis (PCA), particle swarm optimization (PSO), artificial neural networks (ANN) and clustering algorithms [10 - 15] have been used.

This paper makes use of two advanced ensemble algorithms; for Bagging ensemble algorithms, we use the Bagging Classifier model and for Boosting ensemble algorithms, we use the AdaBoost Classifier model. The two models are separately used to predict cervical cancer diagnosis based on 32 documented risk factors and four target variables; Biopsy, Cytology, Hinselmann and Schiller.

3. METHODOLOGY

In this section we describe the models used in our study.

3.1 Bagging Classifier

A bagging classifier is an advanced ensemble technique that combines predictions from several base models to get the final prediction, it does this by fitting each base model on random subsets of the original dataset, then, aggregating their individual predictions either by voting or averaging to get the final prediction. Bagging classifier takes different dimensions; it is known as Pasting, when random subsets of the dataset are drawn as random subsets of the sample [16], Bagging, when samples are drawn with replacement [17], Random Subspaces, when random subsets of the dataset are drawn as random subsets of features [18], and, as Random Patches, when the base models are built on subsets of both samples and features [19].

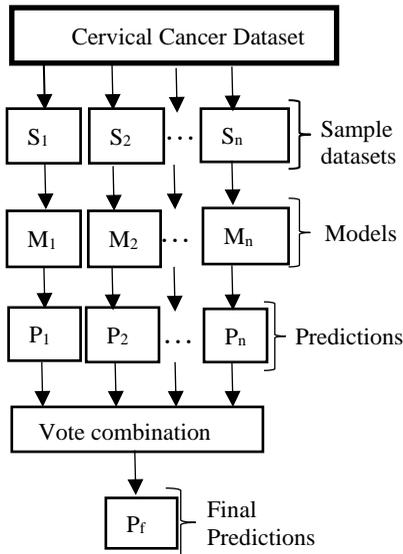


Figure 1. Structure of bagging classifier algorithm

Bagging Classifier Algorithm;

Inputs: Training data **S**; supervised learning algorithm, Base Classifier, integer **T** specifying ensemble size, percent **R** to create bootstrapped training data.

For $t = 1, \dots, T$ **Do**

- i. Take a bootstrapped replica S_t by randomly drawing **R%** of **S**
- ii. Call Base Classifier with S_t and receive the hypothesis (classifier) h_t
- iii. Add h_t to the ensemble, $\mathcal{E} \leftarrow \mathcal{E} \cup h_t$

End For

Simple Majority Voting; given unlabelled instance **x**

- i. Evaluate the ensemble $\mathcal{E} = \{h_1, \dots, h_T\}$ on **x**
- ii. Let $V_{t,c} = 1$ if h_t chooses class ω_c , and 0, otherwise
- iii. Obtain total vote received by each class

$$V_c = \sum_{t=1}^T v_{t,c}, c = 1, \dots, C \quad (1)$$

Output: Class with the highest V_c

3.2 AdaBoost Classifier

AdaBoost is an advanced ensemble technique that makes use of multiple models in a sequential process, where each of the subsequent model attempts to correct the errors of the previous model, it does this by assigning weights to observations which are incorrectly predicted, so that the subsequent model can work to predict these values correctly, it also chooses the training set for each new classifier based on the result of the previous classifier. The succeeding models are dependent on the previous model. AdaBoost can be viewed as a technique that builds on top of other classifiers as opposed to being a classifier itself; it combines multiple weak classifiers into a strong classifier [16,17].

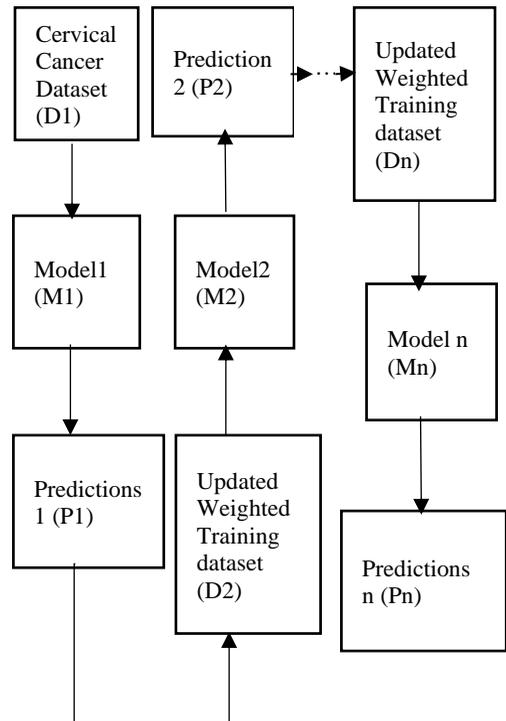


Figure 2. Structure of adaboost classifier algorithm

AdaBoost Classifier Algorithm:

Inputs: Given training data $(x_i, y_i), i = 1, \dots, N$; $y_i \in \{\omega_1, \dots, \omega_c\}$, supervised learner, Base Classifier; ensemble size T

Initialize the distribution $D_1(i) = \frac{1}{N}$

For $t = 1, \dots, T$ **DO**

- i. Draw training subset S_t from the distribution D_t
- ii. Train Base Classifier on S_t , receive hypothesis $h_t: X \rightarrow Y$
- iii. Calculate the error of h_t
 $\epsilon_t = \sum_i I[h_t(x_i) \neq y_i] D_t(x_i)(2)$
If $\epsilon_t > 0.5$ *abort*
- iv. Set $\beta_t = \frac{\epsilon_t}{1 - \epsilon_t}$
- v. Update sampling distribution

$$D_{t+1}(i) = \frac{D_t(i)}{Z_t} \cdot \begin{cases} \beta_t, & \text{if } h_t(x_i) = y_i \\ 1, & \text{otherwise} \end{cases} \quad (3)$$

where $Z_t = \sum_i D_t(i)$ is a normalization factor chosen so that D_{t+1} is a proper distribution function

End For

Weighted Majority Voting; given unlabelled instance z ,

- i. Obtain total vote received by each class

$$V_c = \sum_{t: h_t(z) = \omega_c} \log\left(\frac{1}{\beta_t}\right), c = 1, \dots, C(4)$$

Output: Class with the highest V_c

4. EXPERIMENTS

4.1 Dataset

The dataset used is a Cervical Cancer Risk Factors dataset that was donated by the Hospital Universitario de Caracas in Caracas, Venezuela, on 3rd March 2017, it is found in the University of California at Irvine (UCI) repository. The dataset contains historical records of 858 patients each containing 36 variables; 32 risk factors and four target variables: Hinselmann, Schiller, Biopsy and Cytology. The dataset features contain, patients’ historical medical records, habits and demographic information. The original dataset target variables outcome, yes for ‘1’ and ‘no’ for ‘0’ distribution is shown in Figure 3.

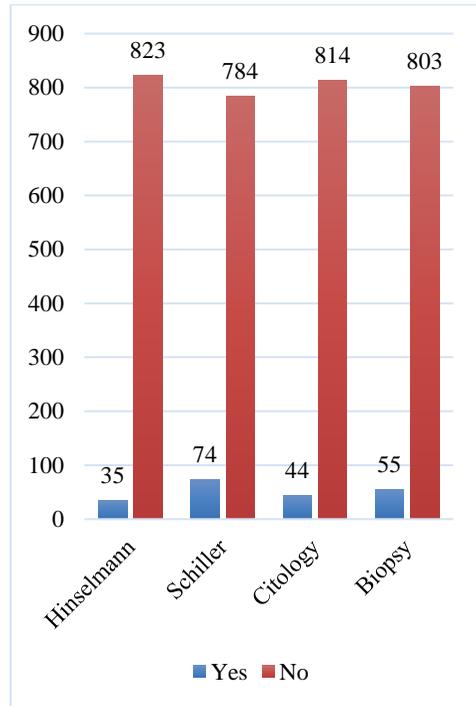


Figure 3. Original dataset target variables outcome distribution

Due to privacy issues, many patients opted not to open up on certain sensitive questions resulting to many missing values in the dataset, hence, so many risk factors and records were removed. After thorough data analysis, several trade-offs were made.

In this study we used all the four target variables and 15 risk factors out of the possible 32 as shown in Table 1, to cater for the huge variation between the Yes and No target variable outcome, each target variable used a specific number of records; for biopsy a total of 90 records were used, for Cytology, 78 records were used, for Hinselmann, 60 records were used, and for Schiller, 126 records were used, each record had the 15 variables. In the end we had four sub datasets, each for a specific target variable.

Table 1. Variables used

No.	Variable	Type
1	Age	int
2	Number of sexual partners	int
3	Number of pregnancies	int
4	Smokes	bool
5	Hormonal Contraceptives	bool
6	IUD	bool
7	STDs	bool
8	STDs: Condylomatosis	bool
9	STDs: Vulvo-perineal Condylomatosis	bool
10	STDs: Syphilis	bool
11	STDs: HIV	bool
12	STDs: HPV	bool
13	STDs: Number of diagnosis	int
14	Dx: HPV	bool
15	Dx	bool
16	Hinselmann: Target variable	bool
17	Schiller: Target variable	bool
18	Cytology: Target variable	bool
19	Biopsy: Target variable	bool

4.2 Evaluation

Experiments were done using Python 3 for Windows, all the four sub datasets were divided into 70% training set and 30% testing set.

To understand how well our models have performed, we present our results in form of confusion matrix, from which we were able to compute our models' accuracy, sensitivity and specificity. We used the confusion matrix to help us identify how many No cases are predicted as No, and how many Yes cases are predicted as Yes, the accuracy metric helps us determine how often the classifier is correct, sensitivity also known as recall which refers to the True Positive Rate (TPR), helps us determine how often the classifier predicts a Yes, when it is actually a Yes, and specificity which refers to the True Negative Rate (TNR), helps us determine how often a classifier predicts a No, when it is actually a No.

The confusion matrix table structure used is shown in Table 2.

Table 2. Confusion matrix

		Predicted Values	
		N	P
Actual values	N	TN	FP
	P	FN	TP

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \quad (5)$$

$$\text{Sensitivity} = \frac{TP}{TP+FN} \quad (6)$$

$$\text{Specificity} = \frac{TN}{TN+FP} \quad (7)$$

4.3 Results

Table 3. Confusion matrix for biopsy test

Biopsy Test		Predicted Values			
		Bagging Classifier		AdaBoost Classifier	
		N	P	N	P
Actual values	N	14	2	15	1
	P	1	10	2	9

From Table 3, the Classifiers each made a total of 27 predictions, in other words, 27 patients took biopsy test. Out of the 27 patients, the Bagging Classifier predicted that 10 patients tested positive and 14 patients tested negative, while AdaBoost Classifier predicted that 9 patients tested positive and 15 patients tested negative. In reality 11 patients in the sample were actually positive and 16 patients in the sample were actually negative.

Table 4. Confusion matrix for cytology test

Cytology Test		Predicted Values			
		Bagging Classifier		AdaBoost Classifier	
		N	P	N	P
Actual values	N	15	1	16	0
	P	1	7	1	7

From Table 4, the Classifiers each made a total of 24 predictions, in other words, 24 patients took Cytology test. Out of the 24 patients, both Classifiers predicted that 7 patients tested positive, Bagging Classifier predicted 15 patients tested negative while AdaBoost Classifier predicted 16 patients tested negative. In reality 8 patients in the sample were actually positive and 16 patients in the sample were actually negative.

Table 5. Confusion matrix for hinselmann test

Hinselmann Test		Predicted Values			
		Bagging Classifier		AdaBoost Classifier	
		N	P	N	P
Actual values	N	7	1	7	1
	P	2	8	1	9

From Table 5, the Classifiers each made a total of 18 predictions, in other words, 18 patients took Hinselmann test. Out of the 18 patients, both Classifiers predicted that 7 patients tested negative, Bagging Classifier predicted 8 patients tested positive, while AdaBoost Classifier predicted 9 patients tested positive. In reality 10 patients in the sample were actually positive and 9 patients in the sample were actually negative.

Table 6. Confusion matrix for schiller test

Schiller Test		Predicted Values			
		Bagging Classifier		AdaBoost Classifier	
		N	P	N	P
Actual values	N	17	2	18	1
	P	3	16	2	17

From Table 6, the Classifiers made a total of 38 predictions, in other words, 38 patients took Schiller test. Out of the 38 patients, Bagging Classifiers predicted that 16 patients tested positive and 17 patients tested negative. AdaBoost Classifiers predicted that 17 patients tested positive and 18 patients tested negative. In reality the sample had 19 patients who were actually negative and 19 patients who were actually positive.

Table 7. Overall results (%)

	Target Variables			
	Biopsy	Cytology	Hinselmann	Schiller
Bagging Classifier				
Accuracy	89	92	83	87
Sensitivity	91	88	80	84
Specificity	88	94	88	89
AdaBoost Classifier				
Accuracy	89	96	89	92
Sensitivity	82	88	90	89
Specificity	94	100	88	95

The overall results in percentages is shown in Table 7. Figure 4 shows the performance of the models. Accuracy, sensitivity and specificity are calculated from the confusion matrix tables. For example, the results for cytology test in AdaBoost is as follows;

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} = \frac{16+7}{16+7+0+1} = \frac{23}{24} = 96\%$$

$$\text{Sensitivity} = \frac{TP}{TP+FN} = \frac{7}{8} = 88\%$$

$$\text{Specificity} = \frac{TN}{TN+FP} = \frac{16}{16} = 100\%$$

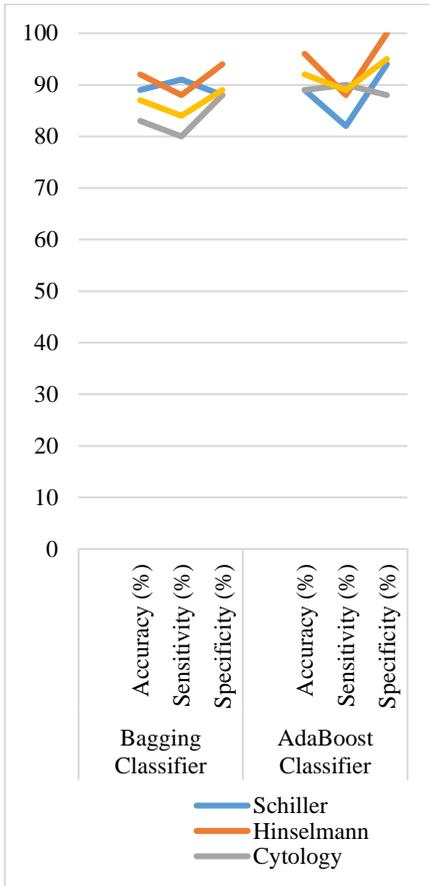


Figure 4. Advanced ensemble models overall performance

5. CONCLUSIONS

The good performance of Bagging Classifier and AdaBoost Classifier can be attributed to the fact that both models use multiple models in order to improve the accuracy of their final predictions, for instance, the Bagging Classifier combine predictions from several model to get the final

prediction, either by averaging or max voting, while, the AdaBoost Classifier follows a sequential process where multiple models are used to make predictions each at a time, and the subsequent model works to correct the errors of the previous model, until the error function remains constant.

Many previous cervical cancer prediction models used the accuracy metric to evaluate how well they performed. However, medical diagnosis is a sensitive procedure that we cannot rely only on the accuracy of a model to judge how well it performs, but, we should also consider how often a model predicts a patient has a disease when the patient actually has the disease, and how often it predicts a patient does not have a disease when the patient actually does not have the disease. This study introduces the performance of two advanced ensemble algorithms; Bagging Classifier and AdaBoost Classifier in cervical cancer prediction. The models are evaluated using, accuracy, sensitivity and specificity metrics.

6. FUTURE WORK

The possible future work related to this study is to first test the efficiency of advanced ensemble models with other cancer risk factors not used in this study, as well as analyse the importance of each risk factor to the target variables, then, explore possibilities of coming up with a mobile app based on the risk factors that women can use to monitor their own cervical health status, as well as network with other women on the same platform. Lastly, is to use the same models and their modified versions in other larger cancer datasets, to see how efficient and effective they are.

REFERENCES

- [1] World Cancer Report. 2014. World Health Org., Geneva, Switzerland.
- [2] Gadducci, A., Barsotti, C., Cosio, S., Domenici, L., and Riccardo A. G. 2011. Smoking habit, immune suppression, oral contraceptive use, and hormone replacement therapy use and cervical carcinogenesis: A review of the literature. *Gynecol. Endocrinol.*, 2011, vol. 27, no. 8, pp. 597–604.
- [3] El-Kareh R., Hassan, O., and Schiff, G. 2013. Use of Health Information Technology to

- reduce diagnostic error. *BMJ Quality and Safety*, 22(Suppl 2): ii40-ii51.
- [4] Quinlann, J. R. *Induction of Decision Trees*. Machine Learning, 1986, 1.1:81 – 106. 1986.
- [5] Zhang C., and Ma, Y. 2012. *Ensemble Machine Learning: Methods and Applications*. Springer Science and Business Media.
- [6] Julian, P. 2004. The cervical cancer epidemic that screening has prevented in the UK. *The Lancet*. 364.9430:249-256.
- [7] Pipti, N. P., and Kishor, H. A. “Cervical Cancer Test Identification Classifier Using Decision Tree Method”, *International Journal of Research in Advent Technology*, 2019. Vol. 7, No. 4, E-ISSN:2321 – 9637.
- [8] Mohammed, F., Kadir, U., and Muciz, S. “Determining Cervical Cancer Possibility by Using Machine Learning Methods”, *International Journal of Latest Research in Engineering and Technology*, 2017. ISSN:2454 – 5031. Vol 03 – Issue 12, pp:65 – 71.
- [9] Vidya, R., and Nasira, G. M. Predicting “Cervical Cancer Using Machine Learning Technologies – An Analysis”, *Global Journal of Pure and Applied Mathematics*, 2016. ISSN 0973 – 1768, vol 12, no 3.
- [10] Kresta, J. V., MacGregor, J. F., and Marlin T. E. 1991. Multivariate statistical monitoring of process operating performance. *Can. J. Chem. Eng.* vol. 69, no. 1, pp. 35–47.
- [11] Salmeron, J. L., Rahimi, S. A., Navali, A. M., and Sadeghpour, A. 2017. 2017. Medical diagnosis of Rheumatoid Arthritis using data driven PSO-FCM with scarce datasets. *Neuro computing*, vol. 232 (April. 2017), pp. 104–112.
- [12] Yin, S., and Huang, Z. 2015. Performance monitoring for vehicle suspension system via fuzzy positivistic C-means clustering based on accelerometer measurements. *IEEE/ASME Trans. Mechatronics*, vol. 20, no. 5 (Oct. 2015), pp. 2613–2620.
- [13] Rodrigues, P. L., Rodrigues, N. F., Fonseca, J. C., Correia-Pinto, C., and Vilaca, J. L. 2014. Automatic modeling of pectus excavatum corrective prosthesis using artificial neural networks. *Med. Eng. Phys.*, vol. 36, no. 10, pp. 1338–1345.
- [14] Yin, S., Gao, H., Qiu, j., and Kaynak, O. 2017. Descriptor reduced-order sliding mode observers design for switched systems with sensor and actuator faults. *Automatica*, vol. 76 (Feb. 2017), pp. 282–292.
- [15] Yin, S., Yang, H., and Kaynak, O. 2017. Sliding mode observer-based FTC for Markovian jump systems with actuator and sensor faults. *IEEE Trans. Autom. Control*, vol. 62 (Jul. 2017), no. 7, pp. 3551–3558.
- [16] Breiman, L. 1999. Pasting small votes for classification in large databases and online. *Machine Learning*, 36(1), 85 – 103.
- [17] Breiman, L. 1996. Bagging predictors. *Machine Learning*, 24(2), 123 – 140.
- [18] Ho, T. 1998. The random subspace method for constructing decision forests. *Pattern Analysis and Machine Intelligence*, 20(8), 832 – 844.
- [19] Louppe, G., and Geurts, P. 2012. Ensembles on Random Patches. *Machine Learning and Knowledge Discovery in Databases*, 346 – 361.

The Effectiveness of Developing Learning Media Based-Lectora Inspire in English Course

Andri Kristianto Sitanggang
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Naeklan Simbolon
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Eva Betty Simanjuntak
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Charles Fransiscus Ambarita
Economic Education Study
Program
State University of Medan
Medan, Indonesia

Laurensia Masri Perangin
Angin
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Dody Feliks Pandimun
Ambarita
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Edizal Hatmi
Primary School Teacher
Education Department
State University of Medan
Medan, Indonesia

Abstract: The research's aim is to determine to find out the increase in college student learning outcomes using learning media based-Lectora Inspire developed in English courses. The Dick and Carey's ADDIE model is being used in this research and development. The college students' cognitive learning outcomes can be improved through the development of learning media based-Lectora Inspire because the gain score obtained is 0.307 which is included in the medium category.

Keywords: Learning Media Based-Lectora Inspire, English Course, Students' Cognitive Learning Outcomes

1. INTRODUCTION

Technological progress is controlled by Human Resources, while Human Resources depend on education. Education is very important to create a smart and quality society. Education is one of the important fields that must be developed in every country. Improvements made in education will determine the progress and retreat of a nation because education is an effort to create quality human resources. Medan State University is one of the higher education institutions in Indonesia that has the responsibility to produce competitive graduates in the form of quality teachers. One of Indonesia's higher education institutions, Medan State University is tasked with producing qualified teachers who are competitive graduates. As an important element of Medan State University, the Faculty of Science Education study program contributes to the achievement of the university's purpose. By helping college students develop their creative thinking abilities which are also important life skills, they may develop a strong graduation profile. The capacity for critical thought is a crucial skill that college students need to have. It is focused on educational objectives that are broadly based, practical, concrete, and meaningful in preparing college students to face future challenges, particularly preparation for the 4.0 industrial revolution. Through mastery of learning,

namely from the outcomes and the actual learning process, the quality of learning is assessed.

However, based on observation at an English course that has been taught at the State University of Medan's Primary School Teacher Education, Faculty of Science Education, it was discovered that the course is dominated by powerpoint learning materials, which makes college students feel bored and less enthusiastic while learning, which makes the learning process ineffective and prevents learning objectives from being met.

Because of this, attention must be paid to student level, the development of students' self-potential, and the use of creative, diverse, fascinating, contextual learning material. In order to build an effective learning process and accomplish learning objectives, this learning medium might start a pleasant learning process. According to Hamidjojo and Latuheru (in Arsyad) suggests that the media as a form of intermediary used by humans to convey or spread ideas, ideas, or opinions so that ideas, ideas or opinions that are delivered to the intended recipient [1]. Meanwhile, Miarso states that learning media are everything that is used to channel messages and can stimulate the thoughts, feelings, attention, and willingness of students so that it can encourage a

deliberate, purposeful, and controlled learning process [2]. As a result, English courses at Primary School Teacher Education study program must construct learning materials. Holding a learning media based-Lectora Inspire platform that is elegantly packed is one of the optimization strategies that lecturers may use.

Based on the background of the study described above, the problem of this study is how is the increase in student learning outcomes using learning media based-Lectora Inspire developed in English course in the Primary School Teacher Education study program, Faculty of Science Education, State University of Medan? The purpose of this study is to find out the increase in student learning outcomes using learning media based-Lectora Inspire developed in English course in the Primary School Teacher Education study program, Faculty of Science Education, State University of Medan.

2. METHOD

This study employed research and development as its methodology. Research and Development is a process or steps to develop a new product or improve an existing product that can be accounted for. These products are not always in the form of objects or hardware, such as books, modules, learning aids in the classroom or in the laboratory, but can also be software, such as computer programs for data processing, classroom learning, libraries or in the laboratory, or models. education, learning, training, guidance, evaluation, management, etc [3]. Dick and Carey's ADDIE model, which is utilized in this study. The product that will be produced in this research is learning media based-Lectora Inspire at English course at Primary School Teacher Education, Faculty of Science Education, State University of Medan. The instruments used are tests. This paper explains about the increase in college student learning outcomes using the product being developed.

3. RESULT AND DISCUSSION

3.1 Result

After the developed product is declared eligible to be tested by material and media experts, it will proceed to the field trial. The trial was carried out in learning using learning media based-Lectora Inspire for the Primary School Teacher Education department college students in class F 2022. The data from the results of this field trial were used to determine the increase in college student cognitive learning outcomes. The results of the field trial are presented in the following table.

Table 1. Pre-Test Result

Respondents	Items															Correct	Score	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93.3	
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0	
3	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
4	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	12	80.0	
5	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	13	86.7
6	1	0	0	0	1	1	1	0	1	0	0	1	0	0	0	6	40.0	
7	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	13	86.7	
8	0	1	1	1	1	1	1	1	1	1	0	1	1	0	1	12	80.0	
9	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	13	86.7	
10	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	12	80.0	
11	0	1	1	1	0	1	1	1	1	1	1	0	1	1	0	11	73.3	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0	
13	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
14	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
15	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
16	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	13	86.7	
17	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	13	86.7	
18	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1	12	80.0	
19	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	13	86.7	
20	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	
21	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	13	86.7	
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0	
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0	
24	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	13	86.7	
25	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	14	93.3	
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0	
27																0	0.0	
28	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
29	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	13	86.7	
30	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3	
31	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	13	86.7	
32	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	13	86.7	
33	0	1	1	1	1	1	1	1	1	1	0	1	1	0	1	12	80.0	
34	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14	93.3	

Based on the table, it can be seen that in the pre-test used 14 items and 34 college students as respondents who answered the items but one of them was not present during the pre-test.

Table 2. Post-Test Result

Respondents	Items															Correct	Score
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0
2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3
3	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93.3
4	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	13	86.7
5	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	12	80.0
6	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	12	80.0
7	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	13	86.7
8	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	86.7
9	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	13	86.7
10	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	12	80.0
11	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	12	80.0
12	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93.3
13	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93.3
14	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93.3
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0
16	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	13	86.7
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0
18	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	13	86.7
19	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93.3
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0
21	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	12	80.0
22	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93.3
23	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3
24	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13	86.7
25	1	1	0	1	1	1	1	1	0	1	0	1	0	1	1	11	73.3
26	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14	93.3
27																0	0.0
28	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	12	80.0
29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	100.0
30	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3
31	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	13	86.7
32	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	14	93.3
33	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14	93.3
34	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	14	93.3

Based on the table, it can be seen that in the pre-test used 14 items and 34 college students as respondents who answered the items but one of them was not present during the post-test.

Table 3. Gain Analysis Of College Students' Cognitive Learning

Subject	Total Pre-test Score	Total Post-test Scores	Sid Gain
1	93,3	100	1,0000
2	100	93,3	0,0000
3	93,3	93,3	0,0000
4	80	86,7	0,3350
5	86,7	80	-0,5038
6	40	80	0,6667
7	86,7	86,7	0,0000
8	80	86,7	0,3350
9	86,7	86,7	0,0000
10	80	80	0,0000
11	73,3	80	0,2509
12	100	93,3	-1,0000
13	93,3	93,3	0,0000
14	93,3	93,3	0,0000
15	93,3	100	1,0000
16	86,7	86,7	0,0000
17	86,7	100	1,0000
18	80	86,7	0,3350
19	86,7	93,3	0,4962
20	93,3	100	1,0000
21	86,7	80	-0,5038
22	100	93,3	0,0000
23	100	93,3	0,0000
24	86,7	86,7	0,0000
25	93,3	73,3	-2,9851
26	100	93,3	0,0000
27			0,0000
28	93,3	80	-1,9851
29	86,7	100	1,0000
30	93,3	93,3	0,0000
31	86,7	86,7	0,0000
32	86,7	93,3	0,4962
33	80	93,3	0,6650
34	93,3	93,3	0,0000
Total Score	2900,0	3053,3	0,307
Score Average	85,3	89,8	0,306
Lowest Score	0,0	0,0	
Highest Score	100,0	100,0	
Gain Category			Sedang

Based on the table, it can be seen that the total pre-test score was 2900, the total post-test score was 3053.3, the average pre-test score was 85.3, the average post-test score was 89.8, the lowest pre-test score was 0, the lowest post-test score is 0, the highest pre-test score is 100, the highest post-test score is 100 and the gain score is 0.307. If seen from the gain score obtained, the increase in college student cognitive learning outcomes is in the medium category. This shows that the use of learning media based-Lectora Inspire can improve college students' cognitive learning outcomes.

3.2 Discussion

The Dick and Carey's ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) is used in this research and development. The results show that the total pre-test score was 2900, the total post-test score was 3053.3, the average pre-test score was 85.3, the average post-test score was 89.8, the lowest pre-test score was 0, the lowest post-test score is 0, the highest pre-test score is 100, the highest post-test score is 100 and the gain score is 0.307. If seen from the gain score obtained, the increase in college student cognitive learning outcomes is in the medium category. Based on the results, the research that has been done proves that college students' cognitive learning outcomes can be improved through the development of learning media based-Lectora Inspire.

4. CONCLUSION

Based on the results, the research that has been done proves that college students' cognitive learning outcomes can be improved through the development of learning media based-Lectora Inspire because the gain score obtained is 0.307 which is included in the medium category.

5. ACKNOWLEDGMENT

Special thanks to Prof. Dr. Baharuddin, M.Pd. for the funds that have been given through the Community Service Institute of State University of Medan, may you always be blessed by God Almighty in your work, health, long life and all elements of life.

6. REFERENCES

- [1] Azhar, Arsyad: Media Pembelajaran. Jakarta (2011).
- [2] Miarso, Yusufhadi: Menyemai Benih Teknologi Pendidikan. Jakarta (2011).
- [3] Sugiyono: Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung (2013).

An Analysis on the Effectiveness of ICT Integration In Learning in Higher Education Institutions in Covid-19 Era

Boniface Mwangi Wambui
Zetech University
School of ICT,Media and
Engineering
Ruiru, Kenya

Hellen Nyambura
Zetech University
School of ICT,Media and
Engineering
Ruiru, Kenya

Nicholas Muriuki
Zetech University
School of ICT,Media and
Engineering
Ruiru, Kenya

Abstract: ICT is utilized extensively in education for several reasons, one of which is that it improves the effectiveness of teaching techniques for both teachers and pupils. ICT integration in education is most often used to describe a technologically oriented teaching and learning process that is closely related to the usage of educational resources in classrooms. Even in the face of unforeseen setbacks like the Covid-19 epidemic, teaching and learning may go on using information and communication technologies (ICT). Instead of being completed in a single phase, ICT adoption is a continuous process that fully supports teaching, learning, and information resources. The purpose of this study was to determine how ICT integration impacted classroom instruction in higher education institutions in light of the Covid-19 outbreak. For this inquiry, a mixed-methods methodology was employed. Data were gathered from both primary and supporting sources. The legitimacy and validity of this study were guaranteed by its quantitative methodology, which provided a clear picture of how ICT integration has helped higher education institutions throughout the Covid-19 pandemic. 207 out of the 225 individuals in the study's sample returned their questionnaires, giving it a 92% response rate. The findings show how ICT integration is highly advantageous for both teachers and students. Teachers who are well-prepared with ICT tools and resources are one of the critical components in the success of technology-based teaching and learning, according to study. According to the results, 50% of respondents thought ICT was very effective, giving it a grade of 75%; 34.4% gave it a rating of 50%; and 15.6% gave it a rating of 25%. Less users accessing the online learning, a lack of ICT resources (9.4%), a lack of internet connections (28.1%), and a lack of online teaching resources (12.5%) were among the challenges faced by 50% of the participants. The researcher's findings indicate that for teachers and students to get the most from ICT adoption, the first phase must be effective. The researchers recommend that the ICT infrastructure at the universities be updated. Plans for addressing any economic issues that colleges and universities may be facing should be developed by the management. ICT equipment may be exempted from taxation or subject to reduced taxation under certain policies, increasing accessibility. Government incentives could also be provided to service providers to increase the scope of their network.

Keywords: Integration, ICT, Training, Education, E-learning, Covid-19

1. INTRODUCTION

Even in the face of unforeseen setbacks like the Covid-19 epidemic, teaching and learning may go on using information and communication technologies (ICT). COVID-19 is taking precautions, including temporary school closures and the use of techniques for physical and social isolation (Fong et al., 2020). Because deadly diseases know no boundaries, the issue requires global attention. (obanolu,2020). To improve the level of care given to COVID-19 patients and lower the danger of viral transmission to other patients or medical personnel, restrictive measures are required (Wong et al., 2020). Curfews, mask wear, and company closures are just a few instances of the stringent precautions that have been put in place to prohibit pandemics from sweeping the globe. The COVID-19 virus, which is sweeping the world, has had major

impact on education institutions as well as many other industries (health, economy, etc.). According to estimates, school cancellations associated with the COVID-19 pandemic protocol have so far had an impact on 63 million instructors and more than 1.5 billion students (UNESCO, 2020; Rezki, 2020). The impacts of the epidemic could affect millions of people who are involved in the educational system, including students, instructors, and their families. In more than 124 nations, including Indonesia, educational institutions had already been closed before the inquiry was done. One of the best ways to reduce the spread of illnesses, especially among children, is to close schools (Jackson et al., 2013).

The absence of face-to-face interaction between teachers and students in the classroom is the most basic definition of

distant learning (Midgely, 2018). Since learners of all academic levels can advance their education without ever setting foot inside a classroom, distance learning differs from traditional classroom instruction. Online education provides a unique way to continue learning in trying times, like the most recent global coronavirus pandemic. Residents in that region should be able to avoid the rapidly spreading pandemic thanks to widespread social limitations that can stop the coronavirus from spreading there (Yunus & Rezki, 2020). According to this strategy, teachers educate students while the pandemic is active from their homes, maximizing ICT use so that students can continue to supervise the learning process from home. Based on information from previous epidemics and observations of student behavior that is regarded appropriate for social interaction, the decision to close schools is made (Jackson et al., 2016; Viner et al., 2020). The widespread use of technology and the global exchange of information affected every industry (Hennessy,2022). Studies have shown how important it is to use ICT in instruction and persuade people of the value of having a thorough personal understanding of ICT (Bai, et al,2021). This significance goes beyond its actual application in instructional strategies as well as its logic and justification.

ICT is widely utilized in education for several reasons, one of which is that it enhances the efficiency of teaching methods for both teachers and pupils. Churchill (2016) recommends increasing students' motivation for learning, their involvement in group projects and class debates, and the quality of education (Cinganotto,2019). These qualities make educational technology a crucial component in the advancement of learning in the present day. Schools and other educational institutions should consider incorporating information, communication, and technology (ICT) into their curricula to prepare students for life in "a knowledge society." ICT integration in education refers to the use of computer-based communication (Rachmawati, 2019). Instead of being completed in a single phase, ICT adoption is a continuous process that fully supports teaching, learning, and information resources.

The phrase "ICT integration in education" is most usually used to describe a technologically oriented teaching and learning process that is closely connected to the usage of educational technologies in classrooms (Ghavifekr & Rosdy, 2015; Sarker et al., 2019). Since children are habituated to www.ijcat.com

technology and learn better in a tech-based environment, ICT integration in schools, particularly in the classroom, is essential. This is because ICT applications, along with ICT features and components, will lead to successful learning. Technology has made significant pedagogical contributions to education. It is true that using technology-based tools and resources can help kids study a variety of disciplines more effectively, starting with math, science, languages, the arts, and other core subjects. The integration strategy aims to boost students' progress and success by implementing the proper usage of ICT in particular subject areas that need complex concepts and skills. A review of the curriculum is also required to ensure that the main goals and objectives of the curriculum are achieved by installing only applicable ICT tools and practical applications. The improvement technique entails using ICT to emphasize the introduced problem strongly. In order to present the material, for instance, in a way that will stimulate conversation and the exchange of ideas, Microsoft PowerPoint might be utilized (Ghavifekr & Rosdy, 2015).

The future of education depends on our ability to comprehend how the epidemic is influencing educational systems all across the world. In fact, studies on how pandemics affect kids, teachers, and parents will act as a guide for what to do in similar circumstances. For the purpose of incorporating technology into education, it will be helpful to understand the effects of such pandemics. Teachers in Turkey have a big responsibility to lessen the COVID-19 pandemic's effects on kids. Teachers assist students in this process by providing them with psychological and educational support. Their views will be important in establishing how the COVID-19 pandemic affects the school system. Utilizing ICT to aid and encourage students' learning is a last complementary technique (Arukaroon & Krairit, 2017). This method helps students to be more productive and organized by taking notes on a computer, delivering their work by email from home as long as the deadline is fulfilled, and researching information from a number of internet sources. The purpose of this study was to determine how ICT integration impacted classroom instruction in higher education institutions in light of the Covid-19 outbreak.

2.0 LITERATURE REVIEW

2.1 Overview of ICT Integration in Education

There is increasing demand on educational systems to use cutting-edge technology to teach students the fundamental skills required in today's society (Rana,2020). For instance, the first Nationwide Educational Technology Plan was released in the US with the goal of preparing students for the 21st century through the provision of computer training, internet access, and other essential tools. (Henderson,2019). According to Ntorukiri et al. (2021), the use of ICT in education will bridge the digital divide and make the nation competitive in terms of workforce expansion and productivity by improving accessibility, boosting productivity, and promoting high-quality education. Evidence suggests that less developed nations have researched how ICT infrastructure affects education more than more developed nations.

It appears that less developed nations have conducted more research on the effects of ICT infrastructure on education than more developed nations. It appears that less developed countries have done more research than more developed ones on the impact of ICT infrastructure on education. It appears that less developed nations have conducted more research on the effects of ICT infrastructure on education than more developed nations. It appears that less developed nations have conducted more research on the effects of ICT infrastructure on education than more developed nations. In order to close that gap, it is critical to examine how Kenya's secondary school teaching and learning are impacted by the ICT infrastructure. By improving accessibility, boosting productivity, and promoting high-quality education, it is anticipated that the integration of ICT in education will close the digital divide and make the nation competitive in terms of workforce growth and productivity. It appears that less developed countries have done more research than more developed ones on the effects of ICT infrastructure on education. In order to close that gap, it is critical to examine how Kenya's secondary school teaching and learning are impacted by the ICT infrastructure.

It is projected that the integration of ICT in education will close the digital divide and make the country competitive in terms of workforce growth and productivity by enhancing accessibility, increasing productivity, and encouraging high-quality education. ICT has gradually been included into the

educational curricula in Kenya, much like it has in other Sub-Saharan African nations (Mariga et al., 2017; Muinde & Mbataru, 2019). The Kenya National Education Sector Plan 2013-2018 placed a lot of emphasis on ICT integration despite the absence of empirical research demonstrating ICT's contribution to better learning across the nation (Piper et al., 2015). This strategy was adopted in line with the National ICT policy, which was put in place in 2006 and aimed to increase the provision of dependable, affordable, and efficient technological services throughout the economy (Republic of Kenya, 2019). In 2020, the COVID-19 epidemic presented a unique challenge for educational institutions all across the world. The vast majority of governments were compelled to close schools and restrict public gatherings in order to curb the spread of the deadly respiratory disease. According to UNICEF, COVID-19 in Kenya caused 20 million pupils to drop out of school (Brown & Otieno, 2020). In order to determine whether alternative teaching methods, such as e-learning, would be advantageous, this study concentrated on how teachers and schools were set up for technology integration before the crisis.

2.2 Impact of Covid-19 on education system

To stop the new coronavirus from spreading, state governments across the country started closing schools and other institutions. It was revealed some time in the second week of March as a temporary tactic to avoid the crowd. When the government first said that schools would be closed for a month, the timeline grew longer; currently, there is no set date for when the schools will reopen. Around this time, important occasions occur, such as competitive exams, entrance exams for different universities, university board exams, semester exams, nursery school admissions, and the university admissions process. There is currently no easy remedy to halt the COVID-19 pandemic.

Closing Kenyan schools and colleges would have a significant negative influence on the social and economic growth of the nation in addition to short-term disruptions to young students' ability to complete their education. The way learning and education are organized has changed as a result of the school closings. It started to have an effect on teaching and evaluating methods. The few private schools that offer online learning have started to implement these techniques. These institutions give their students access to online learning.

(Tarkar,2020). However, there are no e-learning options available, and all low-income private and public schools have been shut down. It hinders children's capacity to learn. Parents are currently coping with a range of issues as a result of the change in teaching methodology. The efficiency of student learning has also been affected by university closures. To ensure continuing at colleges and institutes, one action must be taken immediately away. The class moves more quickly when an online teaching method is used. Universities run their online courses using learning management systems and free and open-source digital learning tools. Higher education, which has been adversely affected by the epidemic, will have a significant impact on the future of the nation's economy.

2.3 Online learning

Some Kenyan students attend universities abroad. The demand for higher education abroad is anticipated to decline as a result of the widespread closure of institutions and universities. Everyone is currently most worried about how the outbreak would impact the employment rate. Recent graduates fear that because of the current situation, job offers from firms would be rescinded. The closure in Kenya has also altered the way that universities and other educational institutions teach. A diversified strategy would be needed to tackle the issue in Kenyan education over the long run.

Nearly everyone in the world has embraced online education since the outbreak (Goldschmidt, 2020). All educational components used in this type of online learning must be able to support learning in order for learning to continue even in the absence of face-to-face interaction. Teachers, who are the primary providers of formal education, are urged to apply learning that was previously delivered in a traditional face-to-face environment but has now gone online. Of all the current options for online learning, it could be claimed that this one has the closest links to in-person training. On the other hand, modern online courses are delivered in accordance with the predetermined course design. A different teaching strategy that can be used in emergency situations is emergency distance education.

Online instructor and student roles, online communication synchronization, online assessment roles, speed, student-teacher ratio, methodology, online instructor and student roles, and feedback sources are just a few of the factors that

must be considered for online learning to be successful. However, given the way the classroom is set up right now, this is only a short-term solution for an urgent remote learning scenario. Because emergency distance learning was performed for a period without a predetermined classroom setup, both students and teachers struggled to adapt to it. Institutions using distance learning should take into account effectiveness learning and addresses a variety of distance learning-related issues, such as interactions with students and their parents or legal guardians, the required infrastructure, the ability of staff to operate distance learning, meeting the need for learning, overcoming obstacles faced by students, school personnel, and outcomes, performance, and feedback from students and staff (Hodges et al,2020).

According to Lugonzo, H. (2020), the Kenyan government's Ministry of Education's online and distance learning programs prohibit students from forming personal relationships with and having intimate contacts with their virtual professors. Online learning is also of little value to the bulk of these students because they do not have access to devices like smartphones, internet connectivity, laptops, televisions, or radios, among other things. He asserts that this has made it more challenging for these underprivileged children to acquire a high-quality education. He suggests conducting research to identify workable mitigating strategies. They claim that problems with computer hardware, electrical power, and internet connectivity were among students' top concerns. While the access to teaching resources, carrying out online instruction, managing the online method of instruction, handling devices, and creating e-content were the main concerns of the teaching staff. In order to stay up with the rapidly evolving global education ecosystem, they contend that the epidemic has exposed faults in the current higher education system and that new legislation should be devised and executed on digital infrastructure. Ngwacho A.G (2020) asserts that COVID-19 shocks have had and will continue to have a detrimental effect on economic growth, which will have an effect on households that are poor, vulnerable, and marginalized and rely on small businesses and unpaid work to maintain their children. He claims that the pandemic has had a significant impact on their capacity to pay for school-related expenses including textbooks, meals, and supplies. According to his theory, students from low-income households will not be able to access these learning mediums as a result of the

government's adoption of remote teaching to support distance learning and online education delivered via radio, television, and the internet. This will widen the gap between access and educational quality.

According to Kamsingi (2021), as part of the Kenya School of Government's Strategic Leadership Development Program. They choose to assist the development of ICT infrastructure as a means of helping public universities deal with the COVID-19 challenges. They recommended that Kenya's government create a comprehensive strategy for funding ICT infrastructure. They argued that because universities had to close, people were forced to enroll in online courses without a reliable ICT infrastructure. They said that fewer students are enrolling in most colleges, especially public universities, and that the capitation of the exchequer has decreased. leading in financial issues for college. They suggested that since the Government of Kenya had been involved in a successful upgrade of technical institutions, a similar method should be utilized to fund ICT in universities.

3.0 METHODOLOGY

A mixed-methods methodology was used for this investigation. Data was collected from both main and auxiliary sources. This study's quantitative methodology, which painted a clear image of how ICT integration has benefited higher education institutions during the Covid-19 epidemic, ensured the study's dependability and validity. The quantitative design uses descriptive statistics to show the distribution of scores using a few indices. A wide spectrum of college students from different universities participated in the study. A survey was conducted on a sample of 225 individuals, and 207 responses were received. The researcher used intended random sampling, so everyone had an equal chance of being chosen for the sample with the intention of answering. Using SPSS version 21, all of the data collected from the respondents was examined (Statistical Package for the Social Sciences). It is also used to compute the mean, standard deviation, frequency, and percentage in order to identify the elements of ICT integration that work best for teaching in higher education institutions as well as the effectiveness of ICT integration for students' learning.

4.0 FINDINGS

The study findings presented in this part are informed by the main research questions.

4.1 Questionnaire response Rate

225 professors and students from higher education institutions were sampled for this study. Out of the total targeted respondents, 207 were able to respond. A 92% response rate was as a result. A response rate of 50% is considered adequate, whereas one of more than 70% is considered good, according to Mugenda & Mugenda (2003). Because of this, the study's response rate was very good.

4.2 Demographic information of the respondents

Table 1: Gender of the students

What is your gender?					
		Frequenc y	Percent	Valid Percent	Cumulative Percent
Valid		3	1.7	1.7	1.7
	Female	79	45.1	45.1	46.9
	Male	93	53.1	53.1	100.0
	Total	175	100.0	100.0	

According to table 2 above 53.1% of the student respondents were male while 45.1% were females.

Table 2: Gender of the teachers

What is your gender					
		Frequenc y	Percent	Valid Percent	Cumulative Percent
Valid		3	9.4	9.4	9.4
	Female	8	25.0	25.0	34.4
	Male	21	65.6	65.6	100.0
	Total	32	100.0	100.0	

According to table 1 above 65.6% of the respondents were male while 25% were females.

Table 3: Teachers level of education

	Frequency	Percent	Valid Percent	Cumulative Percent
Bachelors Degree	12	37.5	37.5	37.5
Diploma	4	12.5	12.5	50.0
Masters	16	50.0	50.0	100.0
Total	32	100.0	100.0	

According to table 2 above 50 % of the teachers had master’s degree,37.5% had Bachelor’s Degree while 12.5% had diploma.

Table 4: Students level of education

What is your highest level of education

	Frequency	Percent	Valid Percent	Cumulative Percent
Bachelor’s Degree	38	21.7	21.7	22.3
Certificate	31	17.7	17.7	40.0
Diploma	100	57.1	57.1	97.1
Masters	3	1.7	1.7	98.9
Other	2	1.1	1.1	100.0
Total	175	100.0	100.0	

According to table 4 above 57.1% of the students had diploma’s,21.7% bachelor’s degree,17.7% certificate,1.7% had masters degree while others had 1.1% .

4.3 Teachers’ perceptions on effectiveness of ICT integration in learning in higher education institutions in covid-19 era

Table 5: Challenges encountered by teachers when teaching online

Which challenges did you encounter when teaching on an eLearning platform during time of COVID-19

	Frequency	Percent	Valid Percent	Cumulative Percent
Few users accessing the platform	16	50.0	50.0	50.0
Lack of ict resources	3	9.4	9.4	59.4
Lack of internet connections	9	28.1	28.1	87.5
Lack of teaching materials	4	12.5	12.5	100.0
Total	32	100.0	100.0	

According to Table 5 above, 50% of the participants experienced difficulties, including fewer users accessing the online learning, a lack of ICT resources (9.4%), a lack of internet connections (28.1%), and a lack of online teaching resources (12.5%).

Which ICT device do you use when teaching during this time of pandemic

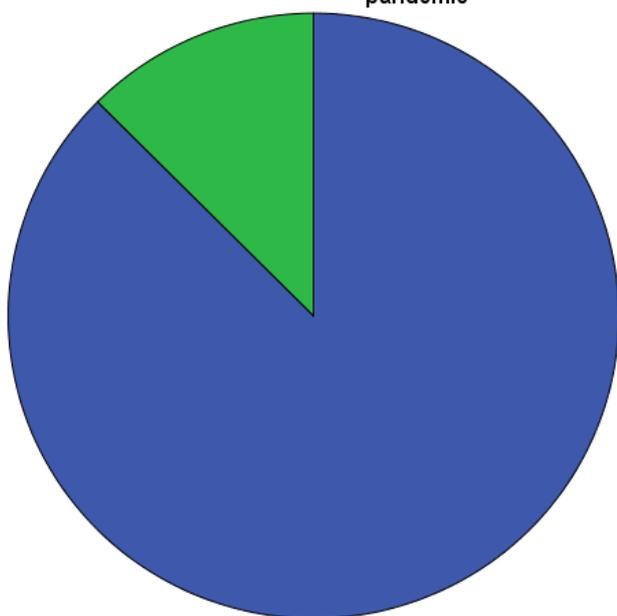


Figure 1: Devices used by teachers when teaching online

According to figure 1 above most of the teachers used laptops to teach online.

Table 6: Availability of Learning Management systems in Higher education institutions (HEI)

Does your institution have a learning management system (LMS), Virtual learning environment (VLE), e-portfolio system or equivalent

	Frequency	Percent	Valid Percent	Cumulative Percent
No	2	6.3	6.3	6.3
Yes	30	93.8	93.8	100.0
Total	32	100.0	100.0	

According to table 6 above 93.8% of the HEI's had a LMS while 6.3% had no virtual system.

Table 7: ICT delivery

Give the percentage at which use of ICT in delivery was more effective over the traditional method (Face to Face).

	Frequency	Percent	Valid Percent	Cumulative Percent
25	5	15.6	15.6	15.6
50	11	34.4	34.4	50.0
75	16	50.0	50.0	100.0
Total	32	100.0	100.0	

According to table 7 above 50% of the respondents asserted that the integration and usage of ICT in delivery was more effective with a 75% and above, 32% provided 100% effectiveness, 34.4% provided 50% while 15.6% gave a percentage of 25 on the effectiveness of ICT over the face to face learning. Technology-based teaching and learning, according to Ghavifekr and Rosdy (2015), offer a variety of engaging ways that will make the learning process more satisfying and meaningful, such as educational videos, stimulation, data storage, database use, mind-mapping, guided discovery, brainstorming, music, and the Internet (www). According to the study's findings, technology-based training and learning are more successful than traditional classroom instruction (Sumitra et al., 2021). This is because active learning environments, which are more engaging and effective for both teachers and students, are created using ICT tools and technology. Additionally, this study showed that the usage of ICT enhances student learning since lesson plans are more interesting and engaging (Hashim et al., 2020).

Does the institution provide internet access to students and staffs? .

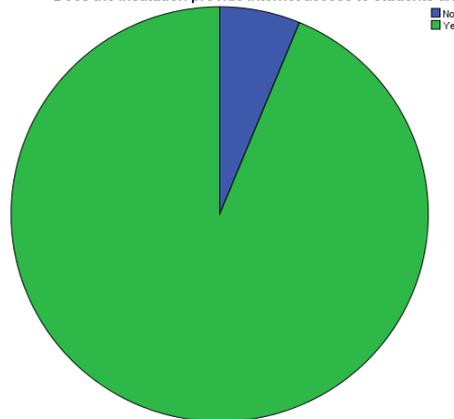


Figure 2: Devices used by teachers when teaching online
 According to figure 2 above most of the HEI's provided internet to both staff and students.

Table 8: ICT delivery

Which ICT device do you use when teaching during this time of COVID-19 pandemic

	Frequency	Percent	Valid Percent	Cumulative Percent
Laptop	28	87.5	87.5	87.5
Valid Mobile phone	4	12.5	12.5	100.0
Total	32	100.0	100.0	

Table 7 shows that 87.5% of the teachers utilized laptops while 12.5% relied on mobile phones to support instruction.

Table 9: Effectiveness of ICT in teaching

Give the percentage at which use of ICT in delivery was more effective over the traditional method (Face to Face).

	Frequency	Percent	Valid Percent	Cumulative Percent
25	5	15.6	15.6	15.6
Valid 50	11	34.4	34.4	50.0
75	16	50.0	50.0	100.0
Total	32	100.0	100.0	

According to table 8 above 50% agree that ICT was very effective with a rating of 75%, 34.4% with a rating of 50% while 15.6% with a rating of 25%.

How would you rate the quality of technological support when teaching on E-learning during Covid -19

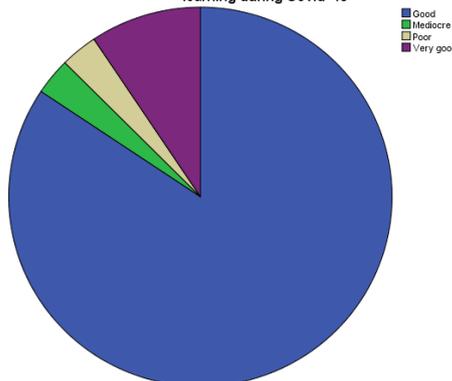


Figure 2: Quality of technological support during covid-19

According to figure 2 above most of the respondents suggested that it was good while a low percentage asserted that it was poor.

Table 10: Likert scale for Teachers’ Understanding & Implementation of Distance Learning during Covid-19 Pandemic

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I am comfortable using a range of ICT tools and software to teach during the COVID-19 Pandemic.	0.0%	0.0%	0.0%	37.5%	62.5%
I find that using ICT resources will help me make sure that the COVID-19 Pandemic learning process is successful.	0.0%	0.0%	0.0%	56.3%	43.8%

For convenient distance learning, there is internet connectivity close to where my students live.	0.0%	3.1%	34.4%	56.3%	6.3%
During the pandemic, I frequently run into challenges when conducting distance learning.	0.0%	12.5%	6.3%	62.5%	18.8%
The COVID-19 pandemic makes distance learning a very difficult and time-consuming option.	0.0%	15.6%	43.8%	34.4%	6.3%
My pupils have sufficient ICT resources for efficient distant learning.	0.0%	3.1%	59.4%	37.5%	0.0%
I chose an ICT device that I am familiar with or frequently use.	0.0%	0.0%	3.1%	46.9%	50.0%

Table 10 reveals that 56.3% strongly agreed while 43.8% strongly agreed that using ICT tools and applications became a solution for them to ensure that the learning process during the COVID-19 Pandemic was successful, and that 62.5% strongly agreed while 37.5% agreed that they were confident using various ICT tools and applications in teaching during the COVID-19 Pandemic. Additionally, 56.3% strongly agreed while 43.8% agreed that the location of their students' residence was reachable in terms of internet access for 62.5% of respondents said they frequently had problems while doing remote learning during the epidemic; 18.8% strongly agreed; 6.3% were undecided; and 12.5% disagreed. Distance learning during the COVID-19 epidemic is very time-consuming and difficult, according to 43.8% of respondents. However, 34.4% agreed, 15.6%

disagreed, and 6.3% strongly disagreed. In terms of whether their pupils had sufficient ICT resources for seamless distance learning, 59.4% of respondents were neutral, 37.5% agreed, and 3.1% disagreed. 50% of respondents strongly agreed, 46% agreed, and 3.1% were neutral about choosing an ICT gadget that they were familiar with or frequently used.

4.4 Students' perceptions on effectiveness of ICT integration in learning in higher education institutions in covid-19 era

4.4.2 Challenges faced by learners

Table 11: Inadequate knowledge of technology

Did Inadequate knowledge of technology affect you in learning?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	2	1.1	1.1	1.1
Yes	95	54.3	54.3	55.4
Total	175	100.0	100.0	100.0

According to table 11 above 44.6% suggested that their lack of knowledge in technology affected their learning while 54.3% were not affected.

Table 12: Failure of LMS

Did the learning management systems (LMS) fail ?

	Frequency	Percent	Valid Percent	Cumulative Percent
Always	3	1.7	1.7	1.7
Sometimes	12	6.9	6.9	8.6
Never	41	23.4	23.4	32.0
Often	59	33.7	33.7	65.7
Seldom	60	34.3	34.3	100.0
Total	175	100.0	100.0	100.0

According to table 11 above 34.3% of the students asserted that the LMS seldom failed,33.7% oftenly,23.4% never while 6.9% suggested that it always failed.

Table 12: Parents perceptions on remote learning

Did varying attitudes, abilities, and resources of your parents regarding remote learning affect you?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1.7	1.7	1.7
May be	42	24.0	24.0	25.7
No	68	38.9	38.9	64.6
Yes	62	35.4	35.4	100.0
Total	175	100.0	100.0	

Table 12 shows that 35.4% of respondents believed that parental perception, lack of resources had an impact on distant learning, 38.9% disagreed, and 24% weren't sure. The instructor uses facilities that are more known to the pupils and are simple to use. When selecting a program to support remote learning, parents must still consider their limited financial means and attitude toward e-learning despite having good internet connectivity (Baloran, 2020; Brooks et al., 2020; Eyles & Montebruno, 2020; Favale et al., 2020; Goldschmidt, 2020; Masters et al., 2020; Shang, 2016; Viner et al., 2020). The reality that the majority of parents experience financial hardship is indicated by the study's insufficiency, the parents' opinions of their own abilities, and their ability to overcome financial challenges.

Table 13: Teachers internet connectivity during teaching

How was your instructor's internet connectivity?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1.7	1.7	1.7
Stable	133	76.0	76.0	77.7
Unstable	39	22.3	22.3	100.0
Total	175	100.0	100.0	

According to table 13 above 76% of the teacher's internet connectivity was stable while 22.3% of them was unstable.

Table 14: Lack of E-learning Login credentials

Did you have Loss of login password issues

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1.1	1.1	1.1
No	122	69.7	69.7	70.9
Yes	51	29.1	29.1	100.0
Total	175	100.0	100.0	

Table 14 shows that whereas 69.7% of respondents were unaffected by a lack of login information, 29.1% of respondents were.

Table 15: Virtual meeting Mode

Which virtual meeting platform worked well with your internet connectivity?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1.7	1.7	1.7
GoogleMeet	22	12.6	12.6	14.3
Kenet Big Blue	38	21.7	21.7	36.0
Microsoft Teams	13	7.4	7.4	43.4
Other	11	6.3	6.3	49.7
WebEx	16	9.1	9.1	58.9
Zoom	72	41.1	41.1	100.0
Total	175	100.0	100.0	

According to table 15 above 41% of the respondents asserted that zoom worked well with regards to internet connectivity, 21.6% preferred Kenet Big Blue Button,12.6% Google Meet,7.4% Microsoft teams,9.1% WebEx while 6.3% had others.

Table 16: Strength of the internet while accessing e-learning resources

Rate your internet connectivity while accessing the e-learning resources

	Frequency	Percent	Valid Percent	Cumulative Percent
	2	1.1	1.1	1.1
Good	111	63.4	63.4	64.6
Poor	17	9.7	9.7	74.3
Very Good	39	22.3	22.3	96.6
Very Poor	6	3.4	3.4	100.0
Total	175	100.0	100.0	

According to table 16 above 63.4% of the respondents ascertained that they had good internet connectivity, 22.3% very good, 9.7% poor, 3.4% very poor while 1.1% never provided any response.

Table 17: ICT integration in teaching and learning as perceived by students using a Likert scale in COVID-19

	Strongly Disagree	Agree	Disagree	Neutral	Strongly Agree
ICT resources are available and in good working order at my school.	0.0%	42.3%	2.3%	9.7%	44.0%
With the use of ICT, I was able to learn more efficiently throughout COVID-19.	1.1%	37.7%	2.9%	18.9%	37.1%
Utilizing ICT during the pandemic advanced my career	0.6%	40.6%	2.9%	16.6%	36.6%

The usage of ICT during the pandemic improves learning	1.7%	38.9%	4.0%	14.9%	37.7%
ICT use during the pandemic aids me in expanding my collection of educational resources.	1.1%	37.1%	2.3%	7.4%	48.6%
Use of ICT during the epidemic improves learner and my collaborative learning	1.7%	43.4%	2.3%	12.6%	37.1%
I was unable to access the virtual classrooms and resources due to unstable Internet.	2.3%	28.6%	5.1%	14.3%	46.3%
The use of ICT during the pandemic motivates students to become more engaged and active.	2.3%	36.6%	4.0%	13.7%	41.1%

Table 17 shows that 42.3% of students highly agreed, 9.7% agreed, 42.3% agreed, and 2.3% strongly disagreed that the ICT facilities in their school are functional and usable. While using ICT during COVID-19, 37.7% of participants agreed that their learning was enhanced; 37.1% strongly agreed; 18.9% were neutral; 2.9% disagreed; and 1.1% severely disagreed. When asked if using ICT during the epidemic had enhanced their professional development, 40.6% said yes, 36.6% said strongly yes, 16.6% said no, 2.9% disagreed, and

0.6% said strongly disagree. When it came to the usage of ICT during the epidemic, 38.9% agreed, 37.7% strongly agreed, 14.9% were neutral, and 4% opposed. The usage of ICT during the pandemic enabled students to be more active and engaged, according to 41% of respondents, 36.6% of respondents agreed, 13.7% were neutral, and 4% disagreed. Lack of reliable Internet access prevented me from accessing virtual classes and materials, according to 46.3% of respondents; the remaining 28.8% agreed, 14.3% were neutral, 5.1% disagreed, and 2.3% strongly disagreed. When it comes to the usage of ICT to improve collaborative learning between students and myself during the pandemic, 37.1% highly agreed, 43.4% agreed, 12.6% were indifferent, 2.3% disagreed, and 1.7% severely disagreed.

5. 0 DISCUSSIONS

According to this survey, even if the majority of teachers think that using ICT in the classroom is beneficial, the resources that are available in schools for using ICT are inadequate and in bad condition, and teachers do not receive enough professional development and training. Although some technological assistance is given, it can occasionally be improved; also, the school's computer lab is not in very good condition despite having functional equipment (Karniawati et al., 2021). Numerous institutions of higher learning have switched from the antiquated classroom model to online courses and from the antiquated offline assessment approach to an online one. They are assessing themselves utilizing internet assessment tools. These restrictions continue to apply to online evaluation tools. Using online evaluation tools, many measurement errors are reported when compared to the norm. Employers evaluate candidates based on their educational credentials, such as grade point averages and degree classifications, according to research by Piopiunik et al. (2020). The inability of recent graduates to obtain employment as a result of the shutdown. The increased candidate signal disruptions are lowering recent graduates' matching efficiency, which results in higher job-separation rates and slower salary growth. According to Fredriksson and Ihlen (2018), this is costly for both the person and society as a whole. Table 9 reveals that, with a rating of 75%, 50% of respondents thought ICT was extremely effective, followed by 34.4% with a rating of 50% and 15.6% with a rating of 25%. Technology-based teaching and learning, according to Ghavifekr and Rosdy (2015), offer a variety of engaging ways

that will make the learning process more satisfying and meaningful, such as educational videos, stimulation, data storage, database use, mind-mapping, guided discovery, brainstorming, music, and the Internet (www). According to the study's findings, technology-based training and learning are more successful than traditional classroom instruction (Sumitra et al., 2021). Since not all schools provide internet data subsidies for students and teachers, some teachers also advise pupils to use low-internet data applications and free websites, such low-cost e-learning (Tuli et al., 2020). (Jackson et al., 2020; Yuhatriati et al., 2020; Brown et al., 2020). Teachers thus urge pupils to use free online learning apps as part of the remote learning strategy.

In response to the COVID-19 outbreak and the decision to close schools, the teachers take the initiative and experiment with distance learning. Up until now, teachers have made a variety of initiatives to ensure that students continue learning and to minimize the flaws and barriers in the learning process. The likelihood of cybercrime assaults that could harm the e-learning system increases with the use of ICT in education. In order to maintain a safe and secure institutional cyberspace, faculty, students, and staff in a higher education institution should be made aware of the institution's technology policies and procedures, as well as best practices for doing so, according to Wambui, B. M (2022). The total growth of society depends on user education. It is more crucial and difficult to protect information integrity and confidentiality in complicated network systems. The bulk of users on these networks is students. Students may engage in cybercrime for a variety of motives, including curiosity or revenge. When asked if using ICT during the epidemic had enhanced their professional development, 40.6% said yes, 36.6% said strongly yes, 16.6% said no, 2.9% disagreed, and 0.6% said strongly disagree. Instructors can quickly get more confidence by undergoing various types of training and having first-hand experience with applying information. Their educational approach to the actual execution of learning will benefit from this. (Eyles, 2018; Valtonen et al., 2015). While conducting remote learning during the pandemic, 62.5% of respondents agreed that they frequently ran into difficulties; 18.8% strongly agreed; 6.3% were neutral; and 12.5% disagreed. This resulted from the shift in teaching methods following school closure. The COVID-19 pandemic triggered school closures, which compelled teachers all across the world to switch to online instruction (Moorhouse, 2020; Pace et al.,

2020). This affects any modifications the teacher makes to the teaching methodology. Teachers must be capable of regulating learning in ways that were not possible before the COVID-19 outbreak. Most of the challenges faced by the students consist of: lack of smartphones to access the eLearning, poor internet connections, too much traffic on the system while having online exams, Problems accessing zipped files and downloading large files while using a phone, Inadequate training on how to use the eLearning system and inadequate support from the instructors on challenges encouraged during the learning period. Power failure, lack of capital to buy bundles and buffering of the internet when the lecturers were teaching which caused poor audio connections.

6.0 CONCLUSION AND FUTURE WORK

The findings demonstrate that this institution's vast majority has access to the necessary ICT infrastructure. To ensure that everyone has access to high-quality, long-lasting education, it is necessary to address the infrastructure problem that exists with effective online/digital learning. Some of the issues that students had to deal with were not being able to open zipped files or download huge files using a phone, getting inadequate training on how to utilize the eLearning system, and not receiving enough support from the instructors while facing challenges while studying. Power outages, a lack of funds to pay for bundles, and internet lag while professors were delivering material all contributed to poor audio connections. The researcher's findings indicate that for teachers and students to get the most from ICT adoption, the first phase must be effective. As a result, proper implementation and support by the school's senior management constitute the first step in preparing for technology-based teaching and learning (Rochmawati & Rahmayanti, 2021). ICT integration in schools will be a tremendous success and have enormous advantages for both instructors and pupils if the deployment procedure is carried out correctly from the very beginning stage and continuous maintenance is efficiently provided (Riyanto et al., 2021). The findings show how ICT integration is highly advantageous for both teachers and students. According to research, one of the key elements in the success of technology-based teaching and learning is teachers who are well-prepared with ICT tools and resources. The researchers recommend that the ICT infrastructure at the universities be updated. Plans for addressing any economic issues that colleges and universities may be facing should be developed

by the management. ICT equipment may be subject to zero rating or reduced taxation under these measures, making them more accessible. Incentives could also be offered by the government to service providers to expand the reach of their network. The government was finally able to develop a Marshall plan to upgrade the ICT infrastructure. Future research should consider other ICT integration factors, particularly from a management perspective with regard to strategic planning and policymaking.

1 ACKNOWLEDGMENTS

Our thanks to the author and co-authors who have contributed towards the completion of this manuscript. Special thanks goes to Zetech university and JFC Medical school for granting permission to conduct the study. Special thanks to my parent Irene Wambui Mwangi for her encouragement during this research.

2. REFERENCES

- [1] Arukaroon, B., and Krairit, D. (2017). Impact of ICT usage in primary-school students' learning in The Case of Thailand. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, 12(2), 21-42
- [2] Alshahrani, S.; Ahmed, E.; Ward, R. (2017). The influence of online resources on student–lecturer relationship in higher education: A comparison study. *J. Comput. Educ* , 4, 87–106
- [3] Bai, B.; Wang, J.; Chai, C.-S. (2021). Understanding Hong Kong primary school English teachers' continuance intention to teach with ICT. *Comput. Assist. Lang. Learn.* , 34, 528–551
- [4] Brown, A., & Otieno, B. (2020, May 7). *Learning from home in Kibera during COVID-19*. UNICEF Kenya. <https://www.unicef.org/kenya/stories/Learning-from-home-in-Kibera-during-COVID-19>
- [5] Brown, K., Toombs, M., Nasir, B., Kisely, S., Ranmuthugala, G., Brennan-Olsen, S. L., Nicholson, G. C., Gill, N. S., Hayman, N. S., Kondalsamy-Chennakesavan, S., & Hides, L. (2020). How can mobile applications support suicide prevention gatekeepers in australian indigenous communities?

- Social Science & Medicine*, 258, 113015.
<https://doi.org/10.1016/j.socscimed.2020.113015>
- [6] Churchill, D.; Lu, J.; Chiu, T.; Fox, B. (2016). *Mobile Learning Design: Theories and Applications*; Springer: Singapore,
- [7] Cinganotto, L.; Cuccurullo, D.(2019). Learning analytics in online social interactions. The case of a MOOC on ‘language awareness’ promoted by the European Commission. *J. E Learn. Knowl. Soc*, 15, 263–286.
- [8] Çobanoğlu, N . (2020). Ethics of Individual, Professional, Social, Scientific and Politic is Questioned By COVID-19 Pandemi. *Anatolian Clinic the Journal of Medical Sciences*, 25(Supplement 1), 36-42.
<https://doi.org/10.21673/anadoluklin.709891>
- [9] Eyles, A., & Montebruno, P. (2020). Covid-19 school shutdowns: what will they do to our children’s education? *Centre for Economic Performance, LSE*, 001(1). <http://cep.lse.ac.uk/pubs/download/cepcovid-19-001.pdf>
- [10] Fredriksson, M., & Ihlen . (2018). Introduction: Public Relations and Social Theory 1. In *Public Relations and Social Theory* (pp. 1-16). Routledge.
- [11] Fong, M. W., Gao, H., Wong, J. Y., Xiao, J., Shiu, E. Y. C., Ryu, S., & Cowling, B. J. (2020). Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings — social distancing measures. *Emerging Infectious Diseases*, 26(5), 976.
<https://doi.org/10.3201/eid2605.190995>
- [12] Goldschmidt, K. (2020). The COVID-19 pandemic: Technology use to support the wellbeing of children. *Journal of Pediatric Nursing*, 53, 88–90.
<https://doi.org/10.1016/j.pedn.2020.04.013>
- [13] Ghavifekr, S., and Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, 1(2), 175-191.
- [14] Goldschmidt, K. (2020). The COVID-19 Pandemic: Technology Use to Support the Wellbeing of Children. *Journal of Pediatric Nursing*.
- [15] G.N. Chemining, S.M.Mbuguah, B.M Sanda, M.A.Elimi , A.H. Mohamed A.A.Hared, C. Oduor. D.N.Kamsingi (2021) A Position Paper On ICT Infrastructure Development Funding Support As A Strategy For Public Universities In Mitigating The Challenges Of Covid-19 . Kenya School of Government.
- [16] Hashim, S., Masek, A., Abdullah, N. S., Paimin, A. N., and Muda, W. H. N. W. (2020). Students’ intention to share information via social media: A case study of COVID-19 pandemic. *Indonesian Journal of Science and Technology*, 5(2), 236-245.
- [17] Hennessy, S.; D’Angelo, S.; McIntyre, N.; Koomar, S.; Kreimeia, A.; Cao, L.; Brugh, M.; Zubairi,(2022) A. Technology Use for Teacher Professional Development in Low- and Middle-Income Countries: A systematic review. *Comput. Educ. Open*, 3, 100080
- [18] Henderson, M.; Ryan, T.; Phillips, M. (2019). The challenges of feedback in higher education. *Assess. Eval. High. Educ*, 44, 1237–1252.
- [19] Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*, 27. <https://er.educause.edu/articles/2020/3/the-differencebetween-emergency-remote-teaching-and-onlinelearning>
- [20] Jackson, C., Vynnycky, E., Hawker, J., & Olowokure, B. (2013). School closures and in fl uenza: systematic review of epidemiological studies. *BMJ Open*, 3(2), 1–10. <https://doi.org/10.1136/bmjopen-2012-002149>
- [21] Jackson, C., Vynnycky, E., & Mangtani, P. (2016). The relationship between school holidays and transmission of influenza in England and wales. *American Journal of Epidemiology*, 184(9), 644–651. <https://doi.org/10.1093/aje/kww083>
- [22] Jackson, J., Iacovides, J., Duncan, M., Alders, M., Maben, J., & Anderson, J. (2020). Operationalizing resilient healthcare concepts through a serious video game for clinicians. *Applied Ergonomics*, 87(April), 103112. <https://doi.org/10.1016/j.apergo.2020.103112>

- [23] Karniawati, N., Simamora, R., and Zain, B. T. (2021). Information Communication and Technology for Political Communication Ethics. *International Journal of Computer in Law and Political Science*, 1, 21-26.
- [24] Lugonzo, H. (2020). A Theoretical Study of the Impact of Corona Virus Crisis on Learners' Social Interaction in Kenyan Learning Institutions. *IJER-International Journal of Educational Research*, 3(04), 09-19.
- [25] Midgely, S. (2018). What is distance learning? The Complete University Guide <https://www.thecompleteuniversityguide.co.uk/distance-learning/what-is-distancelearning/>
- [26] Mariga, G., Ogenga, S., Shikali, C., & Muliaro, J. (2017). Computer laptop project strategy for basic education schools in Kenya. *International Journal of Information and Communication Technology Research*, 7(5).
- [27] Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *Journal of Education for Teaching*, 46, 609–611. <https://doi.org/10.1080/02607476.2020.1755205>
- [28] Muinde, S. M., & Mbataru, P. (2019). Determinants of implementation of public sector projects in Kenya: a case of laptop project in public primary schools in Kangundo sub-County, Machakos County. *International Academic Journal of Law and Society*, 1(2), 328–352.
- [29] Mugenda, O. & Mugenda, A. (2003). *Research Methods; Quantitative and Qualitative Approaches*, Nairobi, Kenya.: Acts Press
- [30] Ngwacho A.G: (2020 COVID-19 Pandemic Impact on Kenyan Education Sector: Learner Challenges and Mitigations Journal for Research innovation and Implication in Education ISSN 2520-7504 (Online) Vol.4, Iss.2, 2020 (pp. 128-139)
- [31] Ntorukiri, T., Mukami, E., Kiara, F., & Celestino, M. (2021). Impact of Integrating ICT Infrastructure in Teaching and Learning in Kenyan Secondary Schools in Meru County Impact of Integrating ICT Infrastructure in Teaching and Learning. *European Academic Research*, 7229-7241.
- [32] Özer, M . (2020). Educational Policy Actions by the Ministry of National Education in the times of COVID-19 Pandemic in Turkey. *Kastamonu Education Journal*, 28(3),1124- 1129. <https://doi.org/10.24106/kefdergi.722280>
- [33] Pace, C., Pettit, S. K., & Barker, K. (2020). Best practices in middle level Quaranteaching: strategies, tips and resources amidst COVID-19. *Becoming: Journal of the Georgia Association for Middle Level Education*, 31(1), 1–13. <https://doi.org/10.20429/becoming.2020.310102>
- [34] Pan, P. J. D., Chang, S. H., & Yu, Y. Y. (2005). A support group for home-quarantined college students exposed to SARS: Learning from practice. *Journal for Specialists in Group Work*, 30(4), 363–374. <https://doi.org/10.1080/0193392050018695>
- [35] Piper, B., Jepkemei, E., Kwayumba, D., & Kibukho, K. (2015). Kenya's ICT policy in practice: the effectiveness of tablets and E-readers in improving student outcomes. *Forum for International Research in Education*, 2(1), 3–18.
- [36] Piopiunik, M, G Schwerdt, L Simon and L Woessman (2020), "Skills, signals, and employability: An experimental investigation", *European Economic Review* 123: 103374
- [37] Prem, K., Liu, Y., Russell, T. W., Kucharski, A. J., Eggo, R. M., Davies, N., Jit, M., Klepac, P., Flasche, S., Clifford, S., Pearson, C. A. B., Munday, J. D., Abbott, S., Gibbs, H., Rosello, A., Quilty, B. J., Jombart, T., Sun, F., Diamond, C., & Hellewell, J. (2020). The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. *The Lancet Public Health*, 5(5), e261–e270. [https://doi.org/10.1016/S2468-2667\(20\)30073-6](https://doi.org/10.1016/S2468-2667(20)30073-6)
- [38] Rachmawati, R. (2019). Utilization and Quality of Information System for Administration Services Based on ICT In Patehan, Kraton, Yogyakarta. *Indonesian Journal of Science and Technology*, 4(1), 55-63.
- [39] Riyanto, Y., Nandiyanto, A. B. D., and Muhammad, N. (2021). The effectiveness of distance teaching and learning activities in primary schools.

Indonesian Journal of Multidisciplinary Research, 1(1), 1-6.

- [40] Sumitra, I. D., Wirawan, E., Putra, M., Kusumaningrat, I., and Maulana, H. (2021). Design of webinar information system for people with hearing impairments. *Indonesian Journal of Community and Special Needs Education*, 1(2), 77-86
- [41] S.M.Mbuguah, (2021) A Position Paper On ICT Infrastructure Development Funding Support As A Strategy For Public Universities In Mitigating The Challenges Of Covid-19 . Kenya School of Government.
- [42] Tuli, S., Tuli, S., Tuli, R., & Gill, S. S. (2020). Predicting the growth and trend of COVID- 19 pandemic using machine learning and cloud computing. *Internet of Things*, 11, 100222. <https://doi.org/10.1016/j.iot.2020.100222>
- [43] Wong, J., Goh, Q. Y., Tan, Z., Lie, S. A., Tay, Y. C., Ng, S. Y., & Soh, C. R. (2020). Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*, 1-14. <https://doi.org/10.1007/s12630-020-01620-9>
- [44] World Health Organization (WHO) (2020). WHO Director-General's Remarks at the Media Briefing on 2019-nCoV on 11 February 2020.
- [45] WorldHealth Organization.(2020).WHODirector-General'sopeningremarksatthe mediabriefng on COVID-19-11 March 2020. <https://www.who.int/dg/speeches/detail/who-director-general-sopening-remarks-at-the-media-briefng-on-covid-19—5-march-2020>. Juni 20, 2020.
- [46] Rana, K.; Greenwood, J.; Fox-Turnbull, W(2020). Implementation of Nepal's education policy in ICT: Examining current practice through an ecological model. *Electron. J. Inf. Syst. Dev. Ctries*, 86, e12118
- [47] Rachmawati, R. (2019). Utilization and Quality of Information System for Administration Services Based on ICT In Patehan, Kraton, Yogyakarta. *Indonesian Journal of Science and Technology*, 4(1), 55-63.
- [48] Regehr, C., & Goel, V. (2020). Managing COVID-19 in a large urban research- intensive University. *Journal of Loss and Trauma*, 25(6-7), 523–539. <https://doi.org/10.1080/15325024.2020.1771846>
- [49] Sarker, M. N. I., Wu, M., Cao, Q., Alam, G. M., and Li, D. (2019). Leveraging digital technology for better learning and education: A systematic literature review. *International Journal of Information and Education Technology*, 9(7), 453-461.
- [50] Tarkar, P. (2020). Impact of COVID-19 pandemic on education system. *International Journal of Advanced Science and Technology*, 29(9), 3812-3814.
- [51] Tian, H., Liu, Y., Li, Y., Wu, C.-H., Chen, B., Kraemer, M. U. G., Li, B., Cai, J., Xu, B., Yang, Q., Wang, B., Yang, P., Cui, Y., Song, Y., Zheng, P., Wang, Q., Bjornstad, O. N., Yang, R., Grenfell, B. T., & Dye, C. (2020). An investigation of transmission control measures during the frst 50 days of the COVID-19 epidemic in China. *Science*, 368(6491), 638–642. <https://doi.org/10.1126/science.abb6105>
- [52] UNESCO (2020). Teacher Task Force calls to support 63 million teachers touched by the COVID-19 crisis. UNESCO. From: <https://en.unesco.org/news/teacher-taskforce-calls-support-63-million-teachers-touched-covid-19-crisis>
- [53] Valtonen, T., Kukkonen, J., Kontkanen, S., Sormunen, K., Dillon, P., & Sointu, E. (2015). The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning. *Computers and Education*, 81, 49–58. <https://doi.org/10.1016/j.compedu.2014.09.008>
- [54] Viner, R. M., Russell, S. J., Croker, H., Packer, J., Ward, J., Stansfeld, C., Mytton, O., Bonell, C., & Booy, R. (2020). School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review. *The Lancet Child and Adolescent Health*, 4(5), 397–404. [https://doi.org/10.1016/S2352-4642\(20\)30095-X](https://doi.org/10.1016/S2352-4642(20)30095-X)
- [55] Wambui, B. M. A Survey of Cyber Crime Awareness Among Netizens of Higher Education Institutions: A Case Study of Zetech University.

- [56] Wang, G., Zhang, Y., Zhao, J., Zhanh, J., & Jianh, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *The Lancet*, 395(10228), 21-27. [https://doi.org/10.1016/S0140-6736\(20\)30547-X](https://doi.org/10.1016/S0140-6736(20)30547-X)
- [57] Yunus, N. R., & Rezki, A. (2020). Kebijakan Pemberlakuan Lockdown Sebagai Antisipasi Penyebaran corona virus covid-19. *SALAM: Jurnal Sosial & Budaya Syar-i*, 7(3), 227–238. <https://doi.org/10.15408/sjsbs.v7i3.15083>
- [58] Samsul, B. (2020). E-Learning as connector among education institution in the 4th industrial revolution. *Journal of Physics: Conference Series*, 1471, 012024. <https://doi.org/10.1088/1742-6596/1471/1/012024>

Sentiment Analysis of YouTube Comments: Potential Indonesian Presidential Election Candidates

Dimaz Cahya Ardhi
Faculty of Engineering
Universitas Bina Insan
Lubuklinggau, Indonesia

Dwi Puspita Sari
Faculty of Engineering
Universitas Bina Insan
Lubuklinggau, Indonesia

Abstract: This study examines the public's sentiments toward potential candidates for the 2024 Indonesia presidential election. This study utilized YouTube comments on the Kompas TV channel, which features videos from potential presidential candidates, as its data source. Coberry is used to download YouTube comments, which are then analyzed using Python using the Pandas Library, matplotlib, wordcloud, and textblob. This study aims to determine the public's response to presidential candidates in the general election of 2024. This study shows that the public has positive sentiments toward the three presidential candidates named Ganjar Pranowo, Anies Baswedan, and Prabowo Subianto.

Keywords: sentimental analysis, YouTube comments, presidential election, WordCloud, Python, Coberry, Tidyverse, Textblob

1. INTRODUCTION

Television and radio have been the primary entertainment media for many people in the past few years. However, with the rapid development of information technology and the increasing number of internet users, social media has become the preferred entertainment media. For example, watching YouTube videos is more attractive for many people than watching television or listening to the radio. YouTube allows users to earn money through AdSense or by directly endorsing certain products or services. YouTube has become the most popular online video-viewing website because it has compensated some creators for the past 15 years [1]. YouTube will likely unveil additional methods for content creators to commercialize their videos and place advertisements in Shorts soon [2]. YouTubers with Millions of subscribers mostly have a team like a video editor, content creator, video graphed, content writer, and video graphics. Maintaining an engaged channel of YouTube to the customer requires the content creators to upload new video content regularly.

Besides public figures, politicians also use social media to gain popularity and use social media as a pipeline to reach people. Today, politicians use social media to promote their work to the public, which can positively affect their electability. For example, two years into the presidential election in Indonesia, the public wanted to know the nominated president from a political party in Indonesia. As a result, Kompas TV nominated Ganjar Pranowo, Anies Baswedan, and Prabowo Subianto as some potential presidential candidates for the Republic of Indonesia in 2024 [3].

This study aims to analyze public sentiment on the electability of the three presidential candidates for the upcoming Indonesian presidential elections in 2024 by analyzing the comments column on the Kompas TV YouTube channel, which has the content of the three candidates. This study will use descriptive data analytics to represent the data retrieved from Kompas TV YouTube channel comments. In addition, this study will analyze the public response to the names of presidential candidates whom various political parties in Indonesia represent. There are three hypotheses from this study as follows.

H1: Ganjar Pranowo, a potential Indonesian presidential candidate for election in 2024, has a positive sentiment.

H2: Anies Baswedan, a potential Indonesian presidential candidate for election in 2024, has a positive sentiment.

H3: Prabowo Subianto, a potential Indonesian presidential candidate for election in 2024, has a positive sentiment.

The research question is that among the three potential presidential candidates: Ganjar Pranowo, Anies Baswedan, and Prabowo Subianto, which presidential candidate has the highest percentage of positive sentiment from the public?

2. RESEARCH METHODOLOGY

2.1 Software

There were two pieces of software used in this study: Coberry and Python. Coberry is open-source software that allows users to easily download YouTube comments, regardless of who owns the channel [4]. Using Coberry, it is simple to extract all YouTube comments and save them in CSV file format. Using Coberry required two steps: copying a YouTube link from which will download the comment dataset and pasting the link to the column for download. The dataset was in CSV file format and consisted of a few columns. Although the dataset was clean, the researchers performed a cleaning dataset to clean the emojis and emoticons. The second piece of software was visual studio code. It is also open-source software, an Integrated Development Environment (IDE) for Python, a statistical computing and graphics programming language. In this study, the researchers used a variety of Python libraries to assist with analyzing the dataset.

2.2 Data Collection and Cleaning

Nowadays, not only individuals who collect and produce data from social media, but many profit and non-profit organizations also take advantage of social media as data sources. Data collection may exist in any form that is either useful or useless. Once the establishment of relation data connections, information surfaces allow individuals to explain knowledge beyond the range of their senses. Organizing, synthesizing, and summarizing information is the foundation of the data and information values to increase comprehension [5]. Therefore, data analytics used to represent an essential arrangement of the data become valuable. The four data analytics categories are descriptive, predictive, diagnostic, and prescriptive [6].

The YouTube comments from the Kompas TV YouTube channel are the data sources of this study. The data was

retrieved and extracted from YouTube comments to CSV file format and called the dataset with read.csv in visual studio code. In this study, the researchers transformed the unstructured text into structured data for easy analysis using the text-mining approach. Text mining is a vast discipline that involves several techniques and technology for extracting interesting and meaningful patterns from textual data sources to uncover a relevant pattern. Some text mining methods included information extraction, retrieval, categorization, clustering, and summarization [7]. Text mining techniques aim to analyze exciting and relevant information effectively and efficiently from large amounts of unstructured data [8].

This study discovers the significance of text classification, as it is necessary to categorize documents based on their content into predetermined categories. The categorization in text mining applied in this research can use as the foundation for the study to categorize the users with positive or negative comments to the YouTube content. The study about analysis and classification of user comments on YouTube videos can classify the comments into four categories such as relevant, irrelevant, positive, and negative, based on the relevancy of the comments to the video content as described in the video description [9].

Besides categorizing the user's comments, this study also used categorization to count the most frequently used words in YouTube comments. The researchers used the WordCloud library to generate word clouds from the CSV file containing the YouTube comments [10]. Data cleansing is used in the data preparation phase to repair and delete inaccurate and incomplete data extracted from YouTube comments, including emojis and emoticons. The data cleaning process begins by checking whether the data is empty or not in the CSV column. After that, clear the sentence from the emoji and emoticons in the comment column. The next step is translating the comment column into English. Its function is to make it easier to analyze sentiment analysis because the library function on WordCloud is more optimal using English.

2.3 Visualization

Visualization is a method and approach for creating images and diagrams to illustrate the analysis results. It is a discursive resource utilized to present statistical information and frequently numerical data in various graphs, charts, and maps, to explain, convince, and narrate a narrative [11]. The objective of information visualization is to visually portray various types of data to facilitate and strengthen cognition by providing intuitive means for information perception and manipulation [12]. Data visualization results from several preprocessing tasks, including data extraction and cleaning.

WordCloud is a frequently used method for visualizing data in data mining. For data visualization using Python, there is a library named WordCloud. This study used the WordCloud library to visualize and analyze the data. Before performing the WordCloud, the researchers ensured that the data were clean and had a matrix dimension. The first data visualization called the function WordCloud specifies the number of frequent terms that should be displayed. The second visualization showed the analysis's sentiment. This study used the package sentimentr to perform sentiment analysis. Sentimentr is a tool for fast calculating text polarity sentiment in the English language at the sentence level with the option of aggregating results by rows or grouping variables. The visualization in this study used was the word's simple histogram value.

2.4 Sentiment Analysis

Sentiment analysis is a subfield of natural language analytics that seeks to correlate the generally presented in an unstructured fashion with belief and acknowledgment [13]. Sentiment analysis, often known as opinion mining, is a natural language processing technique for interpreting and categorizing emotions in subjective data such as emails, social media posts, and survey results. Sentiment analysis aims to define automatic tools to extract subjective information from texts written in natural languages, such as opinions and sentiments, to develop structured and valuable knowledge for either a decision support system or a decision maker [14]. Sentiment analysis is used for this study to systematically identify subjective information through natural language processing and text analysis.

In this study, there were four phases for sentimental analysis, including data gathering, text cleaning, data analysis, and understanding the results. Text cleaning was challenging for the sentimental analysis because the YouTube comments were in Indonesian. Unfortunately, r had a limited package or resources for conducting sentiment analysis in languages other than English. So, the researchers founded a lexicon for Indonesian to weigh the word and a list of Indonesian words to help steam the words. So, the first process for sentiment analysis was using a lexicon in Indonesian to make graph values of words. Then, the second step was using Bing Function from the Tidyverse package to make a histogram of the positive and negative sentiment [15].

3. RESULTS AND DISCUSSION

People have turned to the television and radio to acquire the latest news and enjoy themselves in their leisure time for the past three decades. However, YouTube has gradually shifted the public's interest toward traditional media such as television, radio, newspapers, and magazine [16]. As a result, it has revolutionized how people obtain the latest information and pleasure. Previously, individuals tended to wait until prime time to watch the news. For example, in the morning before work and the evening after work. However, with the advancement of internet technology, people can watch news anytime and anywhere because many national televisions adapt to technological advances by opening the news channel on YouTube.

In Indonesia, national television stations like Metro TV and Kompas TV have a YouTube channel to disseminate the latest news. The researchers use Kompas TV YouTube channel as a case study in this study. Kompas TV is a nationwide private news television network that provides breaking national, international, political, economic, sports, and entertainment news [17]. Kompas TV started as a newspaper company and then developed by establishing a national TV service launched on 9 September 2011 and currently has a YouTube channel named KOMPASTV with about 13.3 million subscriptions [18][19].

Although some potential presidential candidates declared being ready to become presidential candidates in 2022, there have been several names of strong candidates for the 2024 presidential candidates circulating, as mentioned earlier in the introduction section for Indonesian president election in 2024. The candidates are Ganjar Pranowo (@ganjar_pranowo), who is currently a Governor of Central Java; Anies Baswedan (@aniesbaswedan), who is currently a Governor of Jakarta; and Prabowo Subianto (@prabowo) who is currently a Ministry of Defense of Republic Indonesia. Those three potential candidates actively use social media, Instagram, to

connect with the public. However, only Ganjar Pranowo and Anies Baswedan who have the official YouTube account. Prabowo Subianto participated in the election as vice president in 2009 and the presidential election in 2014 and 2019. Unfortunately, he did not win those three previous elections.

A commonly known technique in measuring electability is to survey the public. However, this study experimented to see the electability of the presidential candidate with a new method, sentimental analysis. These results can order strong candidates based on public YouTube comments. In conducting the electability survey, parties or presidential candidates usually hire independent surveys to conduct surveys. Some weaknesses of the organization independence of the survey include the discrepancies between the data analysis techniques and the conclusions drawn in the survey findings [20]. Apart from terms of cost, for getting the sentimental analysis using Python and some of the packages provided on Python, the advantage of using this method was to minimize the possibility of data bias by using the population sampling frame. However, the challenge lies with the user who comments because, in today's digital era, there is a buzzer term, namely an organized and a paid troop of netizens, to comment on social media to benefit, on the one hand, such as popularity or leading opinions.

3.1 WordCloud Analysis

The first WordCloud is a Kompas TV YouTube video about Ganjar Pranowo [21]. The word “president” from the YouTube video may conclude that there is hope from the Indonesian citizen for him to be a presidential candidate in the 2024 presidential election.



Figure. 1 WordCloud of Ganjar Pranowo YouTube Video Comments

The result of figure 1 shows that the word that often comes out is PPP, where PPP stands for Partai Persatuan Pembangunan. It is an Islamic-based political party in Indonesia. There is a possibility that the PPP would support or declare Ganjar Pranowo as a presidential candidate in the 2024 Indonesian presidential election, even though the PPP needed a coalition of other parties. In CloudWord, there is also the word Anies Baswedan. He is also one of the potential candidates for the upcoming Indonesian presidential election. On the YouTube video of Ganjar Pranowo, other words mostly appeared, including candidate, support, and party. The words appeared from WordCloud analysis shows that Ganjar Pranowo is a promising potential candidate for Indonesian president in 2024. However, further investigation is needed because WordCloud only displays words that often appear, so the word can still have a positive or negative meaning.



Figure. 2 WordCloud of Anies Baswedan YouTube Video Comments

Figure 2 above shows the YouTube video comment WordCloud for Anies Baswedan [22]. The word that often appears is Nasdem. Nasdem stands for Nasional Demokrat, is a political party established in 2011. Recently, Nasdem could nominate Anies Baswedan as a potential presidential candidate from this party. The average words that appear are positive. The words DKI and Jakarta also appeared because Anies Baswedan is currently a Governor of DKI Jakarta. Similar to Ganjar Pranowo, WordCloud generates words like president candidate.



Figure. 3 WordCloud of Prabowo Subianto YouTube Video Comments

Figure 3 above shows the WordCloud from the Kompas TV YouTube video for Prabowo Subianto [23]. On WordCloud, there is no Gerindra word appeared. Gerindra is a political party in Indonesia led by Prabowo Subianto. In contrast, the word Nasdem appeared on WordCloud. The word Ganjar Pranowo and Anies Baswedan also appeared in the WordCloud of Prabowo Subianto above because the public may compare Prabowo Subianto with these potential candidates. Words that often appeared are the same as the previous WordCloud for Ganjar Pranowo and Anies Baswedan: president and candidate. Nevertheless, the dominant word that emerged was Prabowo.

3.2 Sentimental Analysis

In the following analysis using textblob, the researchers used polarity as an analysis material with a value of 1 as a positive sentiment sentence and -1 as a negative sentiment, and 0 as a neutral sentiment. Then, the researchers aggregate the number of negative, positive, and neutral sentiments into the histogram chart.

The three tables below show the sentimental analysis for Ganjar Pranowo, Anies Baswedan, and Prabowo Subianto. In addition, the table contains the real YouTube comments, cleansing comments, cleansing comments translated to English, and the polarity.

Table. 1 Sentimental Analysis for Ganjar Pranowo

Content	Cleansing Comment	English Comment	Pol
Maaf saya mau nanya prestasinya gnjar apa	Maaf saya mau nanya prestasinya gnjar apa	Sorry I want to ask achievement of mr ganjar	-1
Hati hati ppp jangan salah pilih capres bisa bisa ga masuk senayan	Hati hati ppp jangan salah pilih capres bisa bisa ga masuk senayan	Be careful PPP don't choose wrong presidential	-1
Wkwkwk p3 mengusung ganjar, aneh dech	Wkwkwk p3 mengusung ganjar, aneh dech	Wkwkwk, P3 carries Ganjar, weird dech	-1
PPP cerdas mengusung gnjar	PPP cerdas mengusung gnjar	PPP smar carrying ganjar	1
Siap dukung ganjar pilpres 2024 apapun partainya	Siap dukung ganjar pilpres 2024 apapun partainya	Ready to support ganjar pilpres 2024 whatever his party	1
Kami pilih ppp jika benar dukung ganjar	Kami pilih ppp jika benar dukung ganjar	We choose PPP, if it is true support gankar	1
Anies yang Amanah yang berpihak sama rakyat	Anies yang Amanah yang berpihak sama rakyat	Anies who is trustworthy	0
Ppp hancu kalua pilih gnjar	Ppp hancu kalua pilih gnjar	Ppp is destroyed if you choose ganjar	0
Pak Ganjar dinanti yang dekat dari semua golongan	Pak Ganjar dinanti yang dekat dari semua golongan	Pak ganjar in the future who is close to all the group	0

Table 1 shows some of the YouTube comments for Ganjar Pranowo. Some YouTube comments questioned Ganjar Pranowo's accomplishments as Central Java governor and said he is not the best candidate for the 2024 presidential election. On the other hand, some people state they are willing to support Ganjar Pranowo's candidacy for the Republic of Indonesia in 2024. In addition, researchers observed that some neutral comments support other presidential candidates, such as Anies Baswedan.

Table. 2 Sentimental Analysis for Anies Baswedan

Content	Cleansing Comment	English Comment	Pol
PDIP takut kalah	PDIP takut kalah	PDIP is afraid of losing	-1
Banteng idiot	Banteng idiot	Idiot Bull	-1
Anies bkn jawa tulen sulit RI 1	Anies bkn jawa tulen sulit RI 1	Anies Bkn	-1
1000% nasdem mencalonkan anies keok 2024	1000% nasdem mencalonkan anies keok 2024	1000% nasdem nominates anies for 2024	0
Nasdem 2024 cium kanvas	Nasdem 2024 cium kanvas	Nasdem 2024 kiss Kanvas	0
Nasdem 2024 cium kanvas	Nama partainya adalah Nasdem	Now the name of the party nasdem	0
Semoga anies dipilih, di rumah gw dikasih wifi gratis dikasih wifi	Semoga anies dipilih, di rumah gw dikasih wifi gratis kalau setiap hujan	I hope anies is chosen, at home I was given a free wifi if every rain I	1

gratis kalau setiap hujan rumah gw gak pernah kena banjir padahal rumah gw kecil	rumah gw gak pernah kena banjir padahal rumah gw kecil	never flood eventhough my house is small	
Nasdem apa kau tak lihat itu di DKI gimana siap siaplah kau tenggelam Nasdem	Nasdem apa kau tak lihat itu di DKI gimana siap siaplah kau tenggelam Nasdem	Nasdem do you not see it in DKI, how come you are ready	1
Siapapun calonnya yang penting yang jadi harus PRIBUMI	Siapapun calonnya yang penting yang jadi harus PRIBUMI	Whoever the candidate is important who must be native	1

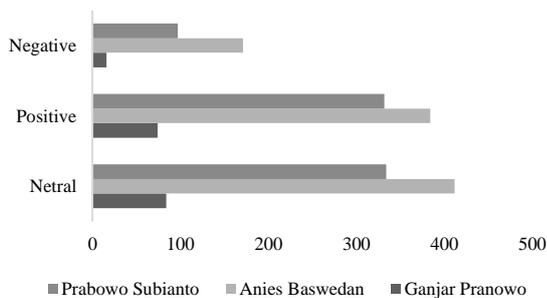
Table 2 above shows some YouTube comments about Anies Baswedan. Some sentiments categorize as positive, negative, and neutral. Among the numerous positive sentimental YouTube comments, some comments are typically negative. For example, even if Anies Baswedan contested the presidential election in 2024, he would still lose. In addition, there are opinions regarding Anies Baswedan's government in Jakarta. There have been no presidents outside Java, even though Anies Baswedan is of Javanese and Arab descent.

Table. 3 Sentimental Analysis for Prabowo Subianto

Content	Cleansing Comment	English Comment	Pol
Prabowo sudahlah wajahmu sdudah terlalu Lelah haha	Prabowo sudahlah wajahmu sdudah terlalu Lelah haha	Prabowo nevermind your face is too tired hahaha	-1
Nasdem Keok 2024 partai gak konsisten	Nasdem Keok 2024 partai gak konsisten	Nasdem is 2024 the party is not consistent	-1
Dulu pendukung Prabowo sekarang saya sarankan prabowo sudahlah anda da tua serahkan sama yang muda	Dulu pendukung Prabowo sekarang saya sarankan prabowo sudahlah anda da tua serahkan sama yang muda	In the past prabowo's supporter now I suggest that Prabowo is already old	-1
Ayo tenggelamkan partainya brewok	Ayo tenggelamkan partainya brewok	Let sink the party beard	0
Selamat pak Prabowo jadi capres abadi	Selamat pak Prabowo jadi capres abadi	Congratulation pak Prabowo jadi presedential candidate	0
Prabowo ganjar untuk RI 2021	Prabowo ganjar untuk RI 2021	Prabowo ganjir for RI 2024	0
Astaqfirullah pak Prabowo bukan negarawan sukses buat pak surya paloh	Astaqfirullah pak Prabowo bukan negarawan sukses buat pak surya paloh	Astaqfirullah mr Prabowo is not a statesman success for mr surya paloh	1
Mau menang duet Prabowo-	Mau menang duet Prabowo-ganjar oklh	Want to win the duet Prabowo-ganjar oklh	1

ganjar oklh			
Selamat tinggal untuk Prabowo tk2024 welcome back anies baswedan muncul 2024	Selamat tinggal untuk Prabowo tk2024 welcome back anies baswedan muncul 2024	Goodbye to Prabowo for 2024 welcome back anies baswedan appered 2024	1

Table 3 above shows some YouTube comments about Prabowo Subianto. There were some negative comments appeared on this YouTube comments. One statement related to "lying" might show as a form of disappointment from the public towards him. Researchers observe that many YouTube comments regarding Prabowo Subiatno are neutral. However, this presents another issue in assessing the natural language process, as there are neutral-sounding remarks whose actual meaning is negative due to the usage of idioms. For instance, the YouTube comment "ayo tenggelamkan partainya brewok" refers to the destruction of the Nasional Demokrasi party. The term "brewok" referred to the Nasional Demokrasi party led by Surya Paloh, who has a beard, and the YouTube comments urged the party's not to nominate Anies Baswedan as the presidential candidate.



The researcher uses the graph above to show the percentage of public comments based on sentimentality. Potential presidential candidate Anies Baswedan has more YouTube comments than the other two potential presidential candidates YouTube comments. So Anies Baswedan has more YouTube comment samples, namely 967 comments. This number was followed by potential presidential candidates Prabowo Subianto and Ganjar Pranowo, with 763 and 174 comments, respectively. From the results above, Ganjar Pranowo has fewer negative sentiment YouTube comments than the 9.2% of the other two candidates. On the other hand, Anies Baswedan is the potential candidate for president who has the highest negative sentiment in YouTube comments, reaching 17.7%. Meanwhile, for positive sentiment, all three have relatively the same percentage with a 40-44% range.

4. FUTURE WORK

Based on the results of this sentimental analysis measurement, the study determined that some YouTube comments had an inaccurate polarity, such as the public's usage of idioms, which translated as a positive but negative sentiment. In a future study, researchers should reexamine and refine the classification of YouTube comments to more precisely determine each comment's polarity. Advanced analytics, also known as predictive analytics, could be used to suggest the most popular YouTube comments as part of the suggested research. Advanced Analytics in future work can use some recommended software, including SAS, Oracle Data Mining, and SPSS, as tools for text mining research [24].

5. CONCLUSION

After researching the videos of the three potential Indonesian presidential candidates, it is possible to conclude that they have more positive than negative sentiments, which has tested the study's hypothesis. The sentimental analysis result showed that Prabowo Subianto is the potential Indonesian presidential candidate with the highest percentage of positive sentiment compared to the other two presidential candidates, with 43.5%. This percentage is followed by Ganjar Pranowo and Anies Baswedan, with 42.5% and 39.7%, respectively. The three potential presidential candidates share similarities with the common appeared words, such as support and presidential candidate. The distinction between the three YouTube videos is that each has a different party name. This is understandable, given that various political parties support the three potential presidential candidates. Although there has been no indication of a proposal from Ganjar Pranowo's PDIP party, the name of the PDIP party and, surprise, the PPP party also appeared. Prabowo Subianto retains the name of his party, Gerindra, although Anies Baswedan's affiliation is the Nasional Demokrasi party. In this study, after employing the word cloud technique, researchers conducted additional analysis utilizing polarity. This technique examines sentiment analysis in further detail. This study determined that the public more frequently discussed Anies Baswedan. Because the researchers found some comments towards him in YouTube video comments about Ganjar Pranowo and Prabowo Subianto that should have negative sentiments toward one candidate. However, the meaning of the sentence was to support Anies Baswedan instead. This is understandable given the recent announcement by a national democrat that Anies Baswedan is actively campaigning to run for president. In the meantime, Prabowo Subianto is a figure who has contested elections in the past.

6. REFERENCES

- [1] Grant, Nico. "YouTube Is Set To Add Ways For Creators To Earn Money." *New York Times* 17 Sept. 2022: B5(L). *Business Insights: Essentials*. Web. 22 Oct. 2022.
- [2] Grant, Nico. "YouTube Opens More Pathways for Creators to Make Money on the Platform." *New York Times* 15 Sept. 2022: B5(L). *Business Insights: Essentials*. Web. 22 Oct. 2022.
- [3] Hardiantoro, A. (2022, September 3). *Survei Nama-nama Capres Potensial di 2024, Ganjar Nomor 1 Halaman all*. KOMPAS.com. <https://www.kompas.com/tren/read/2022/09/03/103000165/survei-nama-nama-capres-potensial-di-2024-ganjar-nomor-1-?page=all>
- [4] Coberry. (n.d.). *YouTube Comments Export, Save as CSV, Comment Analytics*. Coberry. Retrieved October 22, 2022, from <https://coberry.com/youtube>
- [5] Vo T. H, P. (2017). *Python: data analytics and visualization: understand, evaluate, visualize data*. Packt Publishing.
- [6] Amit Kumar Tyagi. (2021). *Data science and data analytics: opportunities and challenges*. C&H\Crc Press.

- [7] Udgave, A., & Kulkarni, P. (2020). Text Mining and Text Analytics of Research Articles. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(6), 4483–4489.
- [8] Talib, R., Kashif, M., Ayesha, S., & Fatima, F. (2016). Text Mining: Techniques, Applications and Issues. *International Journal of Advanced Computer Science and Applications*, 7(11). <https://doi.org/10.14569/ijacsa.2016.071153>
- [9] Kavitha, K. M., Shetty, A., Abreo, B., D'Souza, A., & Kondana, A. (2020). Analysis and Classification of User Comments on YouTube Videos. *Procedia Computer Science*, 177, 593–598. <https://doi.org/10.1016/j.procs.2020.10.084>
- [10] Python Software Foundation. (2018, July 26). *wordcloud*. PyPI. <https://pypi.org/project/wordcloud/>
- [11] Engebretsen, M., & Kennedy, H. (2020). *Data visualization in society*. Amsterdam University Press.
- [12] Po, L., Nikos Bikakis, Desimoni, F., & Papastefanatos, G. (2020). *Linked data visualization: techniques, tools, and big data*. Morgan & Claypool Publishers.
- [13] Kentour, M., & Lu, J. (2021). An investigation into the deep learning approach in sentimental analysis using graph-based theories. *PLOS ONE*, 16(12), e0260761. <https://doi.org/10.1371/journal.pone.0260761>
- [14] Pozzi, F. A., Fersini, E., Messina, E., & Liu, B. (2017). *Sentiment analysis in social networks*. Morgan Kaufmann.
- [15] Tidyverse. (2019). *Tidyverse*. Tidyverse.org. <https://www.tidyverse.org/packages/>
- [16] Setiawan, H., Pawito, & Purwasito, A. (2020). Youtube Social Media Trends Reduce Television Watching Interest. *Proceedings of the 6th International Conference on Social and Political Sciences (ICOSAPS 2020)*, 510. <https://doi.org/10.2991/assehr.k.201219.019>
- [17] Kompas TV. (n.d.). *Berita dan Video Terkini Hari Ini Independen Terpercaya - Kompas TV*. KOMPAS.tv. Retrieved October 22, 2022, from <https://www.kompas.tv/>
- [18] Media, K. C. (2011, September 9). “Kompas” di Layar Kaca Diluncurkan Malam Ini. KOMPAS.com. <https://nasional.kompas.com/read/2011/09/09/16013019/.Kompas.di.Layar.Kaca.Diluncurkan.Malam.Ini>
- [19] YouTube. (n.d.). *KOMPASTV - YouTube*. Wwww.youtube.com. Retrieved October 22, 2022, from <https://www.youtube.com/c/kompastv>
- [20] Zein, R. A. (2018, August 8). *Hasil survei Pilkada tidak akurat, apa yang salah pada lembaga survei?* The Conversation. <https://theconversation.com/hasil-survei-pilkada-tidak-akurat-apa-yang-salah-pada-lembaga-survei-100774>
- [21] KompasTV. (2022, October 11). *Akankah Ganjar Pranowo Diusung Jadi Capres oleh PPP? Mardiono: Akan Diskusi dengan Koalisi*. Wwww.youtube.com. <https://www.youtube.com/watch?v=EQPf1XYnUIU>
- [22] KompasTV. (2022b, October 11). *PDIP Singgung NasDem Usai Usung Anies, Gus Choi: Kenapa Jadi Persoalan?* Wwww.youtube.com. <https://www.youtube.com/watch?v=QLNxlq6SEtU>
- [23] KompasTV. (2022a, October 5). *Respons Singkat Prabowo Soal Nasdem Usung Anies jadi Capres di Pemilu 2024*. Wwww.youtube.com. https://www.youtube.com/watch?v=tz-SNt0Gm_Ybe
- [24] Bose, R. (2009). Advanced analytics: opportunities and challenges. *Industrial Management & Data Systems*, 109(2), 155–172. <https://doi.org/10.1108/02635570910930073>

Development of Weblog for Learning Tool on Creative Product and Entrepreneurship for Tourism Vocational High School

Rotua Sahat Pardamean
Simanullang
Office Administration Education
State University of Medan
Medan, Indonesia

Sri Mutmainnah
Office Administration Education
State University of Medan
Medan, Indonesia

Ellys Siregar
Office Administration Education
State University of Medan
Medan, Indonesia

Gartima Sitanggang
Office Administration Education
State University of Medan
Medan, Indonesia

Abstract : This research aims to test the practicality and effectiveness of weblog for learning tool on Creative Product and Entrepreneurship for Tourism Vocational High School that have been developed using the Borg and Gall Model. The research subjects were teachers and students who used weblog in the implementation of learning in class. Data collection techniques using questionnaires and tests. The questionnaire is used to find out the practicality of the weblog while the test is for the effectiveness of the weblog being developed. The results of the practicality test of developed weblog were obtained from a questionnaire with 30 students with a result of 87% in the very practical category. The effectiveness test in the real class obtained an N-Gain value of 8.2 in the high category with 82% very effective criteria. Thus the weblog contains learning tools and textbooks on Creative Products and Entrepreneurship for Tourism Vocational High Schools that are developed to be practical and effective for use in learning activities.

Keywords: Weblog, Development, Learning Tool and Creative Product and Entrepreneurship, Effectiveness.

1. INTRODUCTION

The rapid development of digital technology has had a major impact on all lines of life, including the education sector. The rapid development of digital technology has contributed a lot to the development and progress of education in many countries. The development of digital technology and communication has greatly helped improve teaching and learning activities that are more efficient, varied and fun. The development of digital technology is usually used as a supporting media for the implementation of learning, to facilitate the delivery of learning material. For this reason, teachers must be able to combine technological advances, pedagogical abilities, and depth of mastery of the content of learning materials into a single unit called Technology Pedagogy Content Knowledge (TPACK).

Technological developments towards digitization have been utilized in learning activities. Digital technology is used to facilitate the implementation of learning activities, which are adapted to the learning material to be studied. The use of digital technology is mandatory in the implementation of 21st century learning. The use of digital technology in

learning can be realized in various forms, one of which is by using weblog. [1] Weblog can be used as a supporting media for the implementation of learning to facilitate the transfer of knowledge from teachers to students. Teachers use the development of digital technology with applications on the internet related to online learning activities so that students can learn anytime and anywhere. Weblog with various features can be used by teachers for teaching and learning activities that can be accessed easily and quickly. The weblog media is in the form of a set of pages that display text data information, still or moving images, animation, sound, video and/or a combination of all of them, including those that have dynamic or static properties that create an interconnected building design, in which each part is associated with networks of page. [2]

Learning support media based on weblog helps students in teaching and learning activities. This is because the weblog media is easily accessible anywhere and anytime, which makes it easier for independent learning students to develop and add insight, learn to interact, and improve their

skills in creating. In addition, students will carry out more and more learning activities because they not only listen to the explanations of the teachers but also other activities, for example making observations and carrying them out. Weblog make it easy to find information. The growth of weblog has the function of being a media that is widely used by the public to find information because it has a practical nature.

Weblogs are a form of web application with writings that are often published sequentially or in reverse order. Website such as weblog can generally be accessed by all internet users in line with the topics sought. The word blog comes from the word weblog which was popularized in early 1998 by John Barger, who gave the word weblog to specify the term website which has a personal nature and is frequently updated all the time. Blog is a website that has a personal nature, which includes personal opinions and other matters in self-actualization and conveying it to the global community. [3] Blog is one of the effective media used in teaching and learning activities in schools because through blog, teachers can transfer material in the form of presentations, animations, videos, texts, online learning, discussions and exams in the same container. The use of weblog media provides students with maximum opportunities through the use of media in learning activities to provide student learning outcomes that experience development. Weblog is a media that have a combined nature through media elements such as multimedia, animation, images, and text that accommodate all elements.[4]

Weblogs can be used to contain all learning tools that will be used in implementing learning activities at school and outside of school. Learning tools available in weblog will facilitate access and use, because the availability of good learning tools will have an impact on the learning process, because they are used as a guide in implementing learning activities in class, laboratory or learning outside the classroom. [5] The completeness of learning tools helps teachers and students in the process of seeking knowledge, because learning tools are the entire design of the implementation of learning that will be carried out, both lesson plans, teaching materials, learning media, student worksheets and also assessment instruments. That is why learning tools are referred to as planning which is a systematic process for deciding what and how students should learn. That is why Ganefri, et al said that the learning tools that were prepared would clearly show the scenario/illustration of the learning activities that would take place in class. Utilization of learning tools weblog for learning activities can be used at all levels of education, including at the secondary school level, both vocational and senior high schools. [6]

Vocational High School is a form of formal education unit that organizes vocational education at the secondary

education level that prepares students to become middle workforce according to their majors, especially to work in their fields. For students, they can continue their education to the college level, but are more focused on becoming a ready-to-use middle workforce. Input for Vocational High Schools are students after completing education at the Junior High School level or equivalent. The organizers of vocational education are divided into two, which can be carried out by the government with public schools and private parties. There are several majors that are usually of interest to prospective Vocational High School students, including the Department of Multimedia, Animation, Administration, Accounting, Pharmacy, Tourism, Shipping, Mechanical Engineering, Catering, Electrical and so on.

Tourism Vocational High School as one of the vocational schools with a large number of enthusiasts. The Tourism Vocational High School is one of the majors with a lot of enthusiasts, as can be seen from the addition of the opening of tourism departments and the increase in the number of students admitted each year. This is also motivated by the large market opportunity in the tourism industry which requires quite a lot of middle workforce, because tourism is big business, with millions of people who want to take advantage of their free time by traveling, medical treatment and religious trips. [7] This is in line with data from the Central Statistics Agency for the last 5 years where there has been an increase in the percentage of workers in the tourism sector to total workers, starting with 9.03% in 2015; 10.37% in 2016; 10.53% in 2017; 11.17% in 2018 to 11.83% in 2019. The tourism sector was also able to create 2.4 million new jobs and contributed 6.2 percent to Indonesia's gross domestic product (BPS, 2020).

Tourism Vocational High School graduates are expected to become middle workforce in the tourism sector, for this reason graduates must be equipped with entrepreneurial competencies. The Subject of Creative Product and Entrepreneurship is one of the subjects to support the achievement of entrepreneurial competence. The government is trying to foster entrepreneurial interest, enthusiasm and skills that will create a young entrepreneurs who graduate from the Tourism Vocational High School. This is because the government is currently focusing on policies on developing creative and reliable human resources who will act as agent of economic development as productive citizens who create jobs for themselves and for others. The government is planning various efforts to create young entrepreneurs to be able to take advantage of local potential and the development of information technology into economic resources. [8] The government's efforts are made by realizing that being an entrepreneur is not easy and instant, but is a behavior that must be developed from an early age[9].

For this reason, it is necessary to standardize learning indicators, teaching material content, learning models, evaluation instruments as outlined in PKK Textbooks and Learning Tools by strengthening a production-based mindset so that every Tourism Vocational High School student has competencies according to the needs of the industrial world. So that students have high-level thinking skills with the ability to connect, manipulate, and transform the knowledge and experience they already have to think critically and creatively in an effort to make decisions and solve problems in new situations. Learning tools used in learning activities must be able to strengthen the mindset of students to become entrepreneurs. Instilling an entrepreneurial spirit requires the growth and strengthening of the mindset, supported by training through practice to produce real products needed by the business world, both goods and services. Students are given learning experiences in contextual situations following the flow of industrial work starting from order-based planning, product implementation and evaluation/product quality control, to post-production service steps. That is why in entrepreneurship learning the process of internalizing students' values needs to be done, because the learning should not only be theory, but the practice of being an entrepreneur. [10] [11]

The research aims to test the practicality and effectiveness of weblog media containing learning tools on Creative Product and Entrepreneurship by strengthening the previously developed production-based mindset. The development of a weblog and a Textbook on Creative Product and Entrepreneurship by strengthening a production-based mindset was carried out due to the lack of textbooks on Creative Product and Entrepreneurship for Tourism Vocational High Schools. The lack of textbooks and digital-based learning tools is an obstacle for students to study business in the tourism industry, while on the other hand the potential for developing the tourism sector is quite high. [11] For the finalization of textbooks that have been developed in previous research, effectiveness tests were carried out through real learning in class with the support of weblog which contain complete learning tools developed which contain Learning Implementation Plans, learning media, student worksheets and evaluation instruments used in learning activities in school.

2. RESEARCH METHOD

Weblogs for learning tools and textbooks have previously been developed using the development model (R&D) Borg and Gall Model, [12] with the aim of developing media weblog containing learning tools on Creative Product and Entrepreneurship by strengthening a production-based mindset to increase the entrepreneurial competence of Tourism Vocational High School students. In this research, practical tests and effectiveness of the two products that had been developed previously were carried out, by applying them to direct learning activities in class.

The location of the research took place at the Department of Travel and Tourism at SMK Negeri 7 Medan. The population in this research were students of SMK 7 Travel Business Department who took the Creative Product and Entrepreneurship Subject. The research samples were in the form of two experimental classes, which were involved in the practicality test and the effectiveness test.

This research uses the development model of Borg and Gall Model to develop a learning tool weblog that starts with a preliminary study in stage one to the revision of the main field test results in the seventh stage, so that it can be used for the operational field test stage in the eighth stage with real learning activities in the experimental class for the finalization of the textbooks and learning tools developed, up to the ninth stage, namely the final product improvement. Data collection techniques used in this research were questionnaires and tests for students. Data analysis techniques with quantitative descriptive analysis techniques to process operational field test results. The effectiveness of the weblog containing learning tools and textbooks developed has been tested using the Gain Normality Test. Gain normality test is a test that can provide an overview of the increase in learning outcomes scores between before and after the application of a treatment. By comparing the scores of pre-test and post-test learning outcomes, it will be known whether the use of weblogs and textbooks is effective or not.

3. RESULT

Research on the development of textbook and learning tool on Creative Product and Entrepreneurship with the strengthening of a production-based mindset has produced Textbooks and Weblog containing Learning Tools in the form of Learning Implementation Plans, teaching materials, learning media, student worksheets and learning evaluation implementation instruments. The development of a learning tool weblog on Creative Product and Entrepreneurship for Tourism Vocational High School students follows the Borg and Gall development procedure with the ten development steps that have taken place in previous research. The previous development stages that have been carried out starting from the first to the fifth stage of the Borg and Gall research stage, and are currently being continued in the sixth to ninth stages, the results are as follows:

3.1. Initial Research and Data Information Collection

The first stage is the initial data collection in the form of preliminary studies and literature, with curriculum analysis and student analysis through Focus Group Discussions with Heads of Departments, teachers and

tourism business entrepreneurs. As a result, the textbook for Creative Products and Entrepreneurship which focus on Tourism High Schools are minimal in number and the learning tools are still manual, not digital technology-based. The learning activities have been carried out with participatory learning to produce products that are marketed in school stores and social media, but have not been oriented towards the needs of the tourism industry.

3.2. Planning of Weblog on Creative Product and Entrepreneurship for Tourism Vocational High School

The second stage is to plan learning tools weblogs according to the syllabus, annual program and semester program at school according to the Vocational High School Expertise Spectrum for the Department of Tourism in the Regulation of the Director General of Primary and Secondary Education, Ministry of Education and Culture Number: 06/D.D5/KK/2018. Learning tools were designed together with the Head of the Department and Teachers of SMK Negeri 7 Medan. The material focuses on practice, by strengthening entrepreneurial mindsets and motivational words of successful entrepreneurs and a collection of videos of North Sumatra tourist objects as tourism resources. Learning media, student worksheets and assessment instruments were prepared using a project approach to explore students' creative abilities and measure needs analysis skills, product design, and marketing. Learning tools explore higher-order thinking skills in problem solving with the direction of reasoning, critical and creative thinking, innovating, communicating and collaborating uploaded to weblog and can be accessed easily by teachers and students.

3.3. Development of Weblog on Creative Product and Entrepreneurship

The third stage is the learning tools that have been developed are published in a weblog to facilitate teacher and student access to learning materials, so that students can access learning materials anytime and anywhere containing Learning Implementation Plans, teaching materials, learning media, student worksheets along with teaching modules . The weblog is also equipped with a pretest, post test and answer key to measure cognitive aspects. The results of the developed Weblog include the following link <https://pkkkmerdeka2022.blogspot.com/> and the developed textbook in the form of an e-book at the Digital Repository of State University of Medan with the link <http://digilib.unimed.ac.id/id/eprint/49096>.

3.4. Initial Field Trial

Weblog have been tested in the initial field, with validation from material experts, media experts and linguists. The results of the validation of the material experts

concluded that learning tool weblog were very feasible with an average of 90% with details of the suitability of the contents of the weblog with the curriculum with a value of 94%, alignment of all learning tools with a value of 89%, and completeness of the content with a value of 87%. For validation, media experts concluded that the weblog in its presentation was very feasible, with an average of 90%. With details of presentation it is very feasible with a value of 90%, with details of the weblog appearance it is feasible with a value of 89% and for ease of use it is in the very feasible category with a value of 91%. The validation results of linguists concluded that weblogs were very feasible with an average of 90%, with very decent readability details with a score of 90%, ease of understanding language was very feasible with a score of 91%, category writing was very feasible with a score of 91%.

3.5. Initial Product Improvement

The fifth stage, namely improving the contents of the blog is carried out based on expert validator input. The initial improvement was in the form of adding a tourist object video link as an illustration of potential, motivational words to build students' entrepreneurial mindset, more detailed features to focus on the material being sought. Strengthening the validator's assessment was followed by tests on three Tourism Vocational High School students with different abilities with average, above average and below average abilities to assess readability, appearance, presentation of material and benefits. The results for assessing the aspects of readability, ease of use and display obtained an average result of 83.99% in the feasible category.

3.6. Main Field Test

The sixth stage, namely in the form of a main field trial to find out the practicality of using a weblog containing learning tools with 30 Tourism Vocational High School students in learning activities using the products produced.

Table 1: Result of Main Field Test

Student	Gain Score	Ideal Score	Empirical Score	Criteria
1	65	75	0,87	Very practical
2	64	75	0,85	Practical
3	65	75	0,87	Very practical
4	63	75	0,84	Practical
5	63	75	0,84	Practical
6	62	75	0,83	Practical
7	65	75	0,87	Very practical

8	67	75	0,89	Very practical
9	68	75	0,91	Very practical
10	70	75	0,93	Very practical
11	63	75	0,84	Practical
12	62	75	0,83	Practical
13	67	75	0,89	Very practical
14	64	75	0,84	Practical
15	68	75	0,91	Very practical
16	65	75	0,85	Practical
17	66	75	0,88	Very practical
18	65	75	0,87	Very practical
19	62	75	0,83	Practical
20	64	75	0,85	Practical
21	68	75	0,91	Very practical
22	64	75	0,85	Practical
23	66	75	0,88	Very practical
24	67	75	0,89	Very practical
25	65	75	0,87	Very practical
26	63	75	0,84	Practical
27	65	75	0,87	Very practical
28	64	75	0,85	Practical
29	66	75	0,88	Very practical
30	65	75	0,87	Very practical
Average			0,87	Very practical

From the results of the main field test for assessing the aspects of readability, ease of use and appearance, an average result of 87% is obtained in the very practical category, meaning that weblog containing practical learning tools and textbooks are used in learning activities.

3.7. Product Revision After Main Field Test

The seventh stage, namely the revision of the learning tool weblog product after the main field trials were carried out with input from students. The fix is in a typing error. The results of the data analysis show that the weblog for learning tool and textbook that developed are feasible and practical to use. Weblog are easy to use, coloring, displaying letters, symbols, pictures, YouTube video links are interesting and don't interfere with the content, look coherent, and help

teachers and students understand the learning material on the weblog.

3.8. Operational Field Test

The eighth stage of operational field testing was carried out in classroom learning activities, using textbooks and learning tools weblog to determine the effectiveness of all the products developed. To find out the effectiveness of the product, a pre-test and post-test were carried out in the experimental class. The pre-test and post-test results were processed using the gain normality test (N-Gain). The results of the effectiveness test were carried out with the following results:

Table 2: Effectiveness Test

No. Student	Pre-Test	Post-Test	N-gain	Criteria
1	15	85	0,82	High
2	5	90	0,89	High
3	10	85	0,83	High
4	25	85	0,80	High
5	35	75	0,62	Medium
6	30	95	0,93	High
7	15	90	0,88	High
8	5	95	0,95	High
9	20	90	0,88	High
10	10	90	0,89	High
11	40	80	0,67	Medium
12	10	90	0,89	High
13	5	80	0,79	High
14	15	85	0,82	High
15	30	90	0,86	High
16	5	85	0,84	High
17	5	75	0,74	Medium
18	15	90	0,88	High
19	5	90	0,89	High
20	5	80	0,79	High
21	10	85	0,83	High
22	15	85	0,82	High
23	15	80	0,76	High
24	5	85	0,84	High
25	25	95	0,93	High
26	10	70	0,67	Medium
27	20	80	0,75	High
28	15	85	0,82	High
29	10	70	0,67	Medium
30	10	90	0,89	High
Average	14,67	85,00	0,82	High
Minimum Value	5,00	70,00	0,62	
Maximum Value	40,00	95,00	0,95	

From the table above, it can be seen that the result of average N-gain for the experimental class with weblog and PKK textbook is 0.82 in the high category when interpreted in the N-gain effectiveness category of 82%, the experimental class is in the effective category for improving student learning outcomes. The results of the N-gain test in

classes using weblog and textbook were developed, namely 0.82, meaning that it was proven effective to apply.

3.9. Final Product Improvement

The ninth stage, namely the final product improvement is carried out as a final correction of the developed textbook and weblog and their contents, based on input on the implementation of the effectiveness test. Corrections are only for writing errors, there are no principle fixes. After the final repairs, both products have been arranged for Intellectual Property Rights and ISBNs for Textbook and Weblog for learning tool on Creative Product and Entrepreneurship for Tourism Vocational High School to be able to enter the final stage, namely Dissemination and Implementation.

4. CONCLUSION

1. The results of field tests and initial product improvements concluded that the weblog for learning tool on Creative Product and Entrepreneurship that developed is suitable for use in the implementation for learning on Creative Product and Entrepreneurship for Tourism High School students, validation of material experts in the very feasible category with an average of 90%, media experts in the feasible category with an average of 89%, linguists with a very feasible category with an average of 90.3%. Strengthened by trials on students with achievement results of 83.99% in the feasible category.
2. The results of the main field test with learning activities in class using weblog and textbook on Creative Product and Entrepreneurship concluded that the two products developed by the weblog and textbook were very practical to use in learning activities on Creative Product and Entrepreneurship for Tourism Vocational High Schools with an average yield of 87% in the very practical category.
3. The results of operational field tests to determine the effectiveness of the weblog and textbook on Creative Product and Entrepreneurship that were developed concluded that the weblog and textbook were effectively used in learning activities with a high N-Gain result of 0.82. This means that the weblog and PKK textbook that were developed are very effectively used in classroom learning activities by 82%.

5. ACKNOWLEDGEMENTS

Special thanks to Dr Samsul Gultom, M.Kes as the Chancellor of the State University of Medan and Prof. Dr. Baharuddin, M.Pd as the Head of the Institute for Research and Community Service, for the research funds that have been given. May you always be blessed by God Almighty in work, health, longevity and all elements of life.

6. REFERENCES

- [1] Amanda, D. T. R. I., Faisal, E. El, & Kurnisar, K. (2018). Pengembangan Media Pembelajaran Weblog Berbasis Saintifik Untuk Membantu Guru Smk Meningkatkan Motivasi Belajar Siswa Pada Materi Dinamika Peran Indonesia Dalam Perdamaian Dunia. Sriwijaya University.
- [2] Trisnowati, E., & Ralasari, T. M. (2019). Pengembangan Media Webblog Untuk Layanan Bimbingan Dan Konseling Di Ikip-Pgri Pontianak. *Sosial Horizon: Jurnal Pendidikan Sosial*, 6(1), 135–148.
- [3] Sartono, S. (2016). Pemanfaatan Blog Sebagai Media Pembelajaran Alternatif Di Sekolah. *Transformatika: Jurnal Bahasa, Sastra, Dan Pengajarannya*, 12(1),102–134.
- [4] Weni, D. M., & Isnani, G. (2016). Meningkatkan Hasil Belajar Siswa Dengan Pengembangan Media Pembelajaran E-Learning Berbasis Blog. *JPBM (Jurnal Pendidikan Bisnis Dan Manajemen)*, 2(2), 114–122.
- [5] Arvianto, Ilham R dan Ardhana, Yosef Murya K. 2019. Pengembangan Perangkat Pembelajaran Untuk Meningkatkan Kemampuan Berpikir Kreatif Dalam Upaya Menuju Era Industri 4.0, *Jurnal Pendidikan Matematika Vol.2 No. 2 Desember 2019*.
- [6] Ganefri et all. 2017. Designing Learning Stages of Production Based Entrepreneurship Learning in the Technology and Vocation Education, Seminar Nasional PIMIMD-4, Institut Teknologi Padang, 27 Juli 2017, ISBN 978-602-70570-5-0
- [7] Simanullang, Rotua Sahat P, Mutmainnah Sri, Siregar Ellys, 2021, Development of Creative Product And Entrepreneurship Textbook With Strengthening the Production-Based Mindset In Vocational School of Tourism, ICIESC 2021, 31 Agustus 2021, DOI 10.4108/eai.31-8-2021.2313805.
- [8] Kurniawan, Asep dan YunYun.2018. Pengaruh Kompetensi Kewirausahaan dan Kelanggengan Usaha Terhadap Keunggulan Bersaing. *Jurnal Inspirasi Bisnis dan Manajemen*. Vol.2,(1),2018,65-78 e-2579-9401, p-2579-9312
- [9] Agung, Dwi Ampuni. 2017. Model Pembelajaran Untuk Mengenalkan Kewirausahaan Pada Siswa

- Sekolah Dasar. Jurnal Bangun Rekaprima Vo. 03/2/Oktober/2017.
- [10] Sulasari, Ayu. 2016. Pengembangan Metode Pembelajaran Kewirausahaan Berbasis proyek untuk Meningkatkan Karakter wirausaha Mahasiswa di Politeknik Negeri Medan. Jurnal Akuntansi dan Manajemen (ABM) Vo. 23 No. 1 (2016). April p.16-28
- [11] Sari, Rapita Ulan, Rusdarti, Rodia Syamwil.2017. Pengembangan Model Pembelajaran Kewirausahaan Berbasis Potensi Lokal Di SMK Wilayah Kalimantan Barat. Journal of Vocational and Career Education (JVCE) 2 (2) (2017)
- [12] Borg and Gall, (1983). Educational Research, An Introduction., New York and London : Longman Inc
- [13] Sundayana, R. (2014). *Statistika Penelitian Pendidikan*. Alfabeta.

Presentation Slide Control Based on Hand Gestures

Nelson Sinaga
Faculty of Engineering
Universitas Negeri Medan
Medan, Indonesia

Baharuddin
Faculty of Engineering
Universitas Negeri Medan
Medan, Indonesia

Hesti Fibriasari
Faculty of Language and Art
Universitas Negeri Medan
Medan, Indonesia

Bakti Dwi Waluyo
Faculty of Engineering
Universitas Negeri Medan
Medan, Indonesia

Joni Syafrin Rambey
Faculty of Engineering
Universitas Negeri Medan
Medan, Indonesia

Abstract: In today's digital world, presentation using a slideshow is an effective and attractive way that helps speakers to convey information and convince the audience. There are ways to control slides with devices like a mouse, keyboard, or laser pointer. The drawback is that one should have previous knowledge about the devices to manage them. Gesture recognition acquired importance a couple of years prior and is utilized to control applications like media players, robot control, and gaming. The hand gesture recognition system is built with gloves and markers. However, using such gloves or tags expands the expense of the system. An Artificial intelligence-based hand gesture detection methodology is proposed in this proposed system. By hand gestures, users can change the presentation slides in forward and backward directions. The use of hand gestures causes the connection simple and helpful and does not need any additional gadgets. The suggested method is to help speakers with a product presentation with naturally improved communication with the computer. Specifically, the proposed system is more viable than a laser pointer since the hand is more apparent and thus can better grab the audience's attention.

Keywords: opencv; hand gesture recognition; presentation slides; machine learning

1. INTRODUCTION

In recent decades Hand gesture recognition has been considered a new technique of Human-Computer Interaction because of its automatic, natural and easiness without requiring input from devices like a keyboard and mouse. For example, detecting spoken language can be done by analyzing lip movements; gaming also uses hand gestures [1]. Now a day's, there are several techniques for hand gesture recognition are in existence on wearable devices like a ring, armbands, gloves, leap motion, and controllers-based motion recognition such as Wii-mote, and ordinary web-camera, stereo cameras, and even using radar, but they still need improvement [2]. So, gesture recognition has gained tons of importance and will not apply. Presentation software control various is one among the various which hand gestures will control.

The machine captures gestures and recognizes them to perform the task. The machine will capture the hand gesture through the camera and recognize it. First background from the captured foreground. This will image recognized motion and remove the filters-out then used for verifying the sign of the gestures. This proposed work aims to implement A.I. in a hand gesture recognition system and use it to control digital presentations using hand gestures.

2. LITERATURE REVIEW

As per the analysis of many other techniques referred to by the researchers, the main aim is to help speakers for a compelling presentation with naturally improved interaction with the computer.

Damiete O. Lawrence and Dr. Melanie J. Ashleigh, author, presented "Impact of Human-Computer Interaction (HCI) on

Users in Higher Educational System: Southampton University as A Case Study". In this paper, Human-Computer Interaction (HCI) perception and impact in the University of Southampton, U.K., an advanced literacy terrain, were measured. The impact of HCI at Southampton University has been positive, showing that getting familiar with HCI generalities ameliorates a stoner's commerce and effectiveness. In conclusion, it can be said that HCI has impacted the literacy terrain as it has impacted other corresponding surroundings [4]. Sebastian Raschka, Joshua Patterson and Corey Nolet presented "Machine Learning in Python: Main Developments and Technology Trends in Data Science, Machine Learning, and Artificial Intelligence". They covered extensively used libraries and generalities, collected for holistic comparison, with the thing of educating the anthology and driving the field of Python machine learning forward [9]. Xuesong Zhai, Xiaoyan Chu, Ching Sing Chai, Morris Siu Yung Jong, Andreja Istenic, Michael Spector, Jia-Bao Liu, Jing Yuan, and Yan Li author presented a Review of Artificial Intelligence (A.I.) in Education from 2010. This study handed a content analysis of studies aiming to expose how artificial intelligence (A.I.) has been applied to the education sector and explore the implicit exploration trends and challenges of A.I. in education [10].

Jadhav & Lobo proposed that static and dynamic gestures are used together to control PowerPoint presentations. To capture and recognize images, Segmentation methodology is used. It also introduces a motion detection feature to change slides [1]. Zhou Ren, Junsong Yuan, Jingjing Meng, and Zhengyou Zhang author presented "Robust Part-Based Hand Gesture Recognition Using Kinect Sensor". They presented a vital part-a grounded hand gesture recognition system using the Kinect detector. A new distance metric, FingerEarth Mover's Distance (F.E.M.D.), is used for diversity measure, which represents the hand shape as a hand with each outlet part as a cluster and

penalizes the empty cutlet- holes. More specifically, our FEMD-grounded hand gesture recognition system achieves 93.2 mean delicacy and runs in 0.0750s per frame when using the thresholding corruption cutlet discovery system [6]. Harika et al. authors proposed and approached a method by using vision-based gesture recognition for a computer-assisted slide presentation. Techniques like the Kalman filter, HSL color model, and Skin color sampling are used. Let us consider the accuracy of this proposed model. Skin color detection has an overall success of about 72.4%, Single fingertip detection has an accuracy of 74.0%, the success rate in moving slides is 77%, and the Success rate in controlling finger-pointing is 80% [2]. Wahid et al. proposed and approached a method to Recognize Hand Gestures Using Machine-Learning Algorithms. Considering the accuracy of this proposed model, The SVM algorithm yielded the highest classification accuracies using both original E.M.G. features (97.56%). It normalized E.M.G. features (98.73%) among N.B., R.F., K.N.N. and DA [3].

Ajay Talele, Aseem Patil, and Bhushan Barse presented "Detection of Real author Time Objects Using TensorFlow and OpenCV". This paper introduced a cutting-edge computer innovative and prescient-based impediment detection technique for cellular generation and its packages. Each character image pixel is classified as belonging to an impediment based totally on its look. This paper presented a brand-new approach for impediment detection with a single webcam digital camera [7]. Ahmed Kadem Hamed AlSaedi, Abbas H. Hassin Al Asadi author, presented "A new hand gestures recognition system". They introduced a low-cost system to fete the hand gesture in real-time. Generally, the system is divided into five ways, one for image accession, alternate to pre-processing the Image, third for discovery and segmentation of hand region, four to features birth and five to count the figures of fritters and gesture recognition. The paper answered the challenge of gyration, exposure, and scaling and got the same results when using the right or left hand. The handed system uses only bare hands and the laptop's webcam, which is veritably flexible for the stoner. The system results show that the recognition rate was 96.6%, which is considered veritably good compared with other exploration papers [8]. Dhall et al. Discovered Hand gesture technology and a Convolutional neural network to build a hand gesture recognition application in the "Automated Hand Gesture Recognition using a Deep Convolutional Neural Network model" paper. In this paper, the author used a CNN, which has specific layers such as the input layer and output layer, and in between them, there are some hidden layers. The first hidden layer is the convolutional layer, which detects and extracts features from images, then the Max pooling layer is used for dimensionality reduction [5].

3. METHODOLOGY

3.1 Image Pre-Processing

The point of pre-processing is to improve the standard of the Image so that we will examine it in an exceptionally better manner. By pre-processing, we will smother undesired distortions and upgrade a few essential elements for the application we are working for. Those features might vary for different applications.

Steps for Image pre-processing:

- Select a boundary of the input image within which we will scan for the presence of a person's hand.

- Produce a mask by opting only pixels that match a specified color range.
- Blur the mask image so that missing data points can be filled.
- Draw a hand contour and use Open CV to identify the fingers.

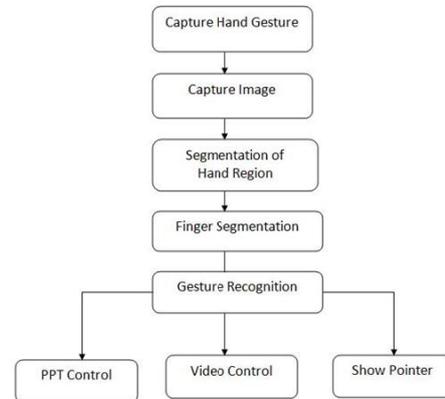


Figure 1. The flow of the system

3.2 Anaconda Framework

Anaconda is used for scientific computing like data science, A.I. applications, massive scope information handling, and predictive analysis, which expects to improve package executives and management. PyCharm is a devoted Python Integrated Development Environment (IDE) executing an enormous scope of required devices for Python engineers, firmly incorporated to establish a helping climate for helpful Python, web, and data science improvement.

3.3 Libraries

3.3.1 OpenCV

OpenCV is used in computer vision, image processing, and machine learning applications. OpenCV guides many programming languages like Python, C++, Java, etc. The identification of objects, faces, or even the handwriting of a human can be made by the action of images and videos. It is an open-source library used to accomplish tasks like face detection, object tracking, landmark detection and many others. It is used to capture the video and to perform the hand detection process:

```
cap = cv2.VideoCapture(0)
```

3.3.2 PyAutoGui

The mouse and keyboard can be controlled to do different things. It is a cross-stage G.U.I. automation Python module for human reality. This third-party library can be installed by using the command pip install pyautogui. It is used to press HotKeys:

```
pg.hotkey('escape')
```

3.3.3 MediaPipe

MediaPipe is a framework that is used for working in a machine-learning pipeline. It is a high-fidelity hand and finger-hunting solution. It is just a part of a single frame that employs machine learning (ML) to derive a 3D marker of a hand. It is used in the hand detection process:

```
self.mpHands = mp.solutions.hands
self.hands = self.mpHands.Hands(self.mode,
self.maxHand,self.detectionCon,self.trackCon)
self.mpDraw = mp.solutions.drawing_utils
```

3.3.4 Keyboard

It records the keyboard action and assists in entering keys; thus can also block the keys until a stated key is entered and affect the keys. It captures onscreen keyboard events as it takes all the keys. This module provides group hotkeys. It is used to press keys:

```
keyboard.press_and_release('ctrl + 1')
```

3.3.5 Numpy

NumPy may be used to carry out various mathematical operations on arrays. It provides effective information systems to Python to ensure treasured computations with arrays and matrices. It offers a massive library of high-stage mathematical features to perform on data structures like arrays and matrices. It is used for Creating a 3*3 kernel:

```
kernel = np.ones((3,3),np.uint8)
```

To define the range of skin color in HSV:

```
lower_skin = np.array([0,20,70], dtype = np.uint8)
upper_skin = np.array([20,255,255], dtype = np.uint8)
```

Convert to the coordinates:

```
x3 = np.interp(x1, (frameR, wCam - frameR), (0, wScr))
y3 = np.interp(y1, (frameR, hCam - frameR), (0, hScr))
```

3.3.6 Time

The Python time module helps represent time in code; representation can be in objects, strings, and numbers. Using this module, other functionality can be implemented, like representing time and measuring the efficiency of your code. It is used to set the frame rate:

```
cTime = time.time()
fps = 1/(cTime - pTime)
pTime = cTime
```

3.3.7 Math

The Python Math Library implements some math features and constants in Python. These features can be used in code to perform complicated mathematical computations. The library does not require installation as it is an essential Python module. It is used to find the length of all sides of the triangle:

```
a = math.sqrt((end[0] - start[0])**2 + (end[1] - start[1])**2)
b = math.sqrt((far[0] - start[0])**2 + (far[1] - start[1])**2)
c = math.sqrt((end[0] - far[0])**2 + (end[1] - far[1])**2)
s = (a+b+c)/2
ar = math.sqrt(s * (s - a) * (s - b) * (s - c))
```

To apply the cosine rule:

```
angle = math.acos((b**2+c**2-a**2)/(2*b*c)) * 57
```

3.4 Finger Count Using Distance Transform

3.4.1 Calculation of finger count

After the skin segmentation, the binary Image of the segmented hand region I.B. is obtained and processed using distance transform. The distance transform method gives the distance (Euclidean distance) of each pixel from the nearest boundary pixel. The distance from the boundary to a pixel in the hand region increases as the pixel is away from the boundary. Using this distance value, the centroid of the palm region can be calculated.

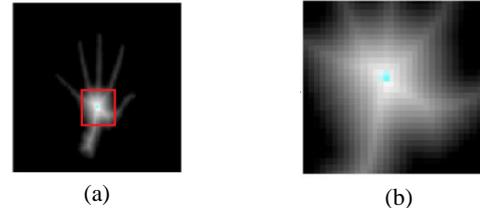


Figure 2. (a) image showing hand region after applying distance transform; (b) the enlarged Image of the region with the red rectangle

Fig. 2(a) shows the image I.D. of the hand after applying the distance transform, and Image Fig. 2(b) shows the enlarged view of the region within the red rectangle. The white color in the center is intense, and the color fades as the distance from the center increases. From this, it is evident that the pixels near the boundary have lower values for distance and those away from the boundary have higher values for distance. This middle region with the highest value for distance is considered the centroid.

The hand region's width will be approximately twice the distance from the centroid to the nearest boundary pixel (say 2d), as shown in Fig. 3. The width of each finger is approximately one-fourth of the hand's width (i.e., ¼ of 2d). A suitable structuring element S (disc) that can erode the fingers thoroughly is chosen, and erosion is performed on the segmented hand region.

$$Rr_1 = I_B \ominus S \quad (1)$$



Figure 3. Image showing the width of the hand 2d and d the distance between the center of the hand nearest boundary pixel

The dilated palm region Rp_2 is subtracted from the original binary Image I_B to give the finger regions F_B alone, as shown in Fig. 4(c).

$$F_R = I_R - RP_2 \quad (2)$$

The number of fingers used to represent the gesture is found by drawing a line along the central axis of the segmented finger regions, as shown in Fig. 4(b). The number of lines drawn is equal to the number of active fingers. This count is used to control the slides of PowerPoint.

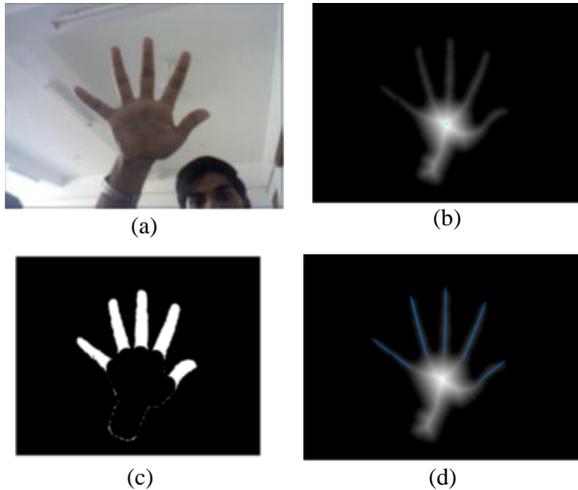


Figure 4. (a) input image I from the user; (b) image I_D of hand region after applying distance transform; (c) the finger regions F_R after erosion, dilation, and subtraction; (d) the fingers count by drawing lines along the central axis of finger regions

Since gesture recognition depends purely on the number of active fingers, any finger can denote a count. Only the count value of the active fingers is taken as input. So, the user can feel free to represent a count irrespective of the finger. Hence value one denoted by the user using the index finger or thumb will be the same as shown in Fig. 5 (a) and (b).

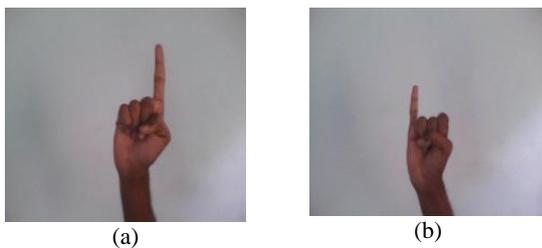


Figure 5. (a) and (b) various gestures to represent the number one

Table 1. Gestures and their functions

No Hand (s)	Finger Count	Functions
One hand	0	The transition from one gesture to another
One hand	1	Next slide
One hand	2	Previous slide
One hand	3	Slide show
One hand	4	Stop slide show
Two hands	The sequence of digit number	Go to the specified slide number

The slideshow is controlled by taking the finger count, calculated using distance transform as input from the user. The gestures used to control the slide show are mentioned in Table 1.

When both hands represent the number of the slide the user needs to navigate, both hands represent the first digit of the number, and both hands are closed. After this, both hands are used again to represent the next digit of the slide number.

4. RESULTS

Place Tables/Figures/Images in the text as close to the reference as possible (see Figure 1). It may extend across both columns to a maximum width of 17.78 cm (7").

- OK (thumb up): The OK gesture presentation will start in presentation mode (Figure 6).
- Two Fingers (victory): Doing two-finger gesture videos will be played or paused in the presentation slide (Figure 7).
- Good: doing a Good gesture presentation will show the previous slide. Users can change the slide backward (Figure 8).
- Three Fingers: The next slide will be presented by making three fingers gesture (Figure 9).
- Four Fingers: The video volume will decrease by making four fingers gesture (Figure 10).
- Five fingers (Palm): Video volume will be increased by making five fingers gestures (Figure 11).
- One finger: by making the one-finger gesture, the user can point some information using a pointer (Figure 12).
- Fist: doing a fist gesture presentation will exit from presentation mode (Figure 13).



Figure 6. OK gesture

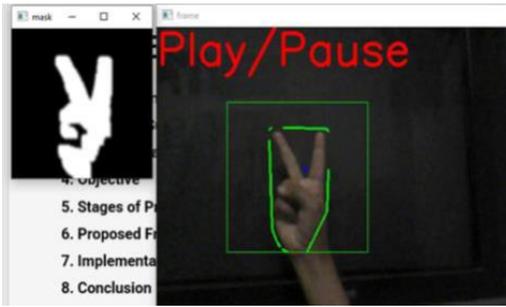


Figure 7. Two fingers gesture

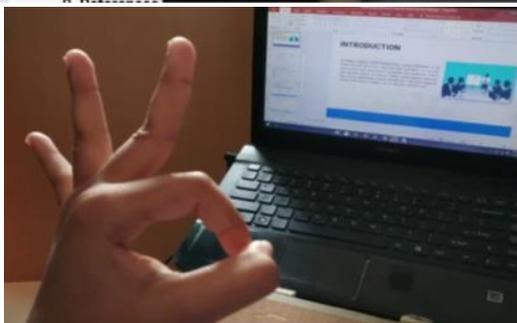
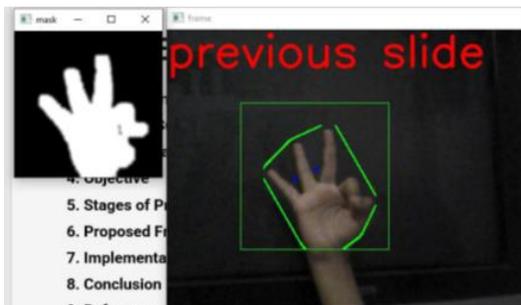


Figure 8. Good gesture

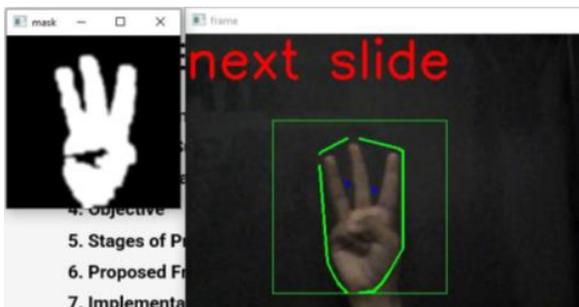


Figure 9. Three fingers gesture

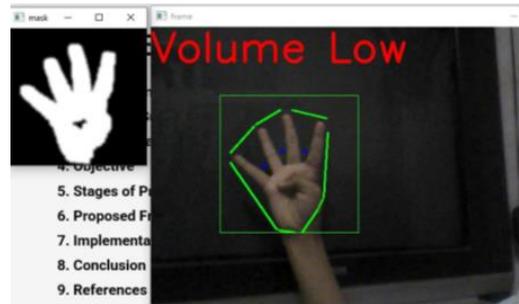


Figure 10. Four fingers gesture

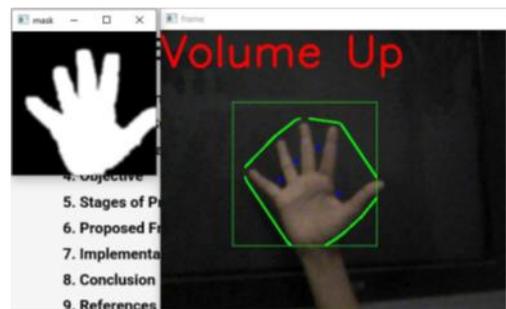


Figure 11. Five fingers gesture



Figure 12. One finger gesture

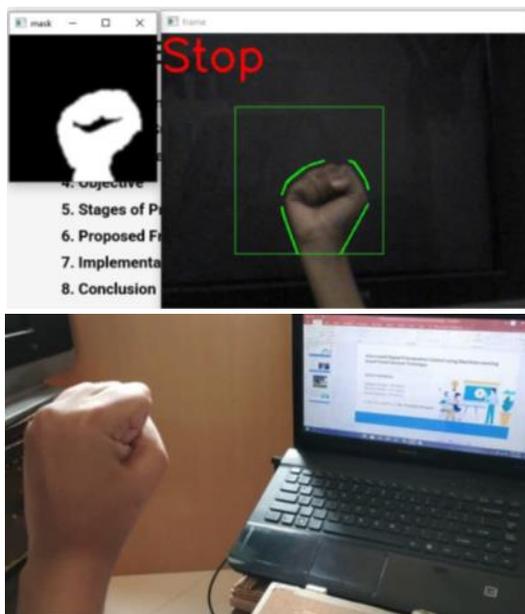


Figure 13. Fist gesture

5. DISCUSSION

Hand gestures are more natural in interaction as they are an essential part of body language, compared with other devices. The use of hand gestures does not require any extra device and makes interaction easy. In this proposed system, an AI-based hand gesture detection methodology is proposed. Using hand gestures would make it easy for the speaker to present more easily. This proposed system aims to develop software that will

help the presenter control the presentation slides by using different hand gestures. With this software, no device like a keyboard, mouse or even remote for changing slides will be needed.

6. CONCLUSION

This proposed system, "Automated Digital Presentation Control Using Hand Gesture Technique," makes presentation easy. The presenter will be able to change slides without using any external device. This will be useful in corporate or institutions where presentation is part of work.

7. REFERENCES

- [1] D. Jadhav, Prof. L.M.R.J. Lobo, Hand Gesture Recognition System To Control Slide Show Navigation I.J.A.I.E.M., Vol. 3, No. 4 (2014)
- [2] M. Harika, A. Setijadi P, H. Hindersah, Finger-Pointing Gesture Analysis for Slide Presentation, Bong-Kee Sin Journal Of Korea Multimedia Society, Vol. 19, No. 8, August (2016)
- [3] Md.F. Wahid, R. Tafreshi, M. Al-Sowaidi, R. Langari, An Efficient Approach to Recognize Hand Gestures Using Machine-Learning Algorithms, IEEE 4th M.E.C.B.M.E., (2018)
- [4] D.O. Lawrence, and Dr. M.J. Ashleigh, Impact Of Human-Computer Interaction (Hci) on Users in Higher Educational System: Southampton University As A Case Study, Vol.6, No 3, pp. 1-12, September (2019)
- [5] I. Dhall, S. Vashisth, G. Aggarwal, Automated Hand Gesture Recognition using a Deep Convolutional Neural Network, 10th International Conference on Cloud Computing, Data Science & Engineering (Confluence), (2020)
- [6] Ren, Zhou, et al. Robust part-based hand gesture recognition using kinect sensor, IEEE transactions on multimedia 15.5, pp.1110-1120, (2013)
- [7] Ajay Talele, Aseem Patil, Bhushan Barse on the Detection of Real Time Objects Using TensorFlow and OpenCV, Asian Journal of Convergence in Technology, Vol 5, (2019)
- [8] Ahmed Kadem Hamed AlSaedi, Abbas H. Hassin Al Asadi, A New Hand Gestures Recognition System, Indonesian Journal of Electrical Engineering and Computer Science, Vol 18, (2020)
- [9] Sebastian Raschka, Joshua Patterson and Corey Nolet, Machine Learning in Python: Main Developments and Technology Trends in Data Science, Machine Learning, and Artificial Intelligence, (2020)
- [10] Xuesong Zhai, Xiaoyan Chu, Ching Sing chai, Morris Siu Yung Jong, Andreja Istenic, Michael Spector, Jia-Bao Liu, Jing Yuan, Yan Li, A Review of Artificial Intelligence (A.I.) in Education from 2010 to 2020, (2021)

A Review of the Effects of Fifth-Generation Mobile Networks (5G) on the Fourth Industrial Revolution (Industry 4.0) and the Digital Transformation of Businesses

Duncan Nyale
School of Computing and Mathematics
The Cooperative University of Kenya
Nairobi, Kenya

Charles Katila
School of Computing and Mathematics
The Cooperative University of Kenya
Nairobi, Kenya

Abstract: More than just a generational shift, the arrival of 5G creates a whole new range of opportunities for every sector of the economy. It signifies a significant change in the function that mobile technology serves in society. As 5G becomes a reality, it will have a huge impact on us, particularly at work. This paper's goal is to conduct a thorough literature review, investigate how intelligent automation might be enabled or streamlined by 5G, and discuss why 5G development and deployment are critical in the future years. This article emphasizes the significance of 5G revolutionary networks, evaluates its essential enabling technologies, looks at its trends and issues with adaptation, looks at its applications in various industries, including Industry 4.0 and digital marketing, and emphasizes its function.

Keywords: 5G, 5G Networks, Cellular Wireless Networks, Digital Marketing, Digital Transformation, Enhanced Mobile Broadband (eMBB), Internet of Things (IoT), Mobile Communications, Workplace Transformation

1. INTRODUCTION

According to Attaran & Attaran. (2020), Diverse industries have a chance to become more competitive and make a bigger contribution to local economies thanks to the Fourth Industrial Revolution, which also advances the Sustainable Development Goals of the UN. The internet of things, artificial intelligence, sophisticated data analytics, robotic process automation, robots, cloud computing, virtual and augmented reality, 3D printing, and drones are some of the existing and new technologies driving this industrial revolution. Connectivity is one of the main facilitators that makes it possible for these technologies to reach their full potential.

Networks of physical infrastructure have undergone changes during industrial revolutions. The Second and Third Industrial Revolutions were propelled by electricity as networks realized economies of scale by connecting massive facilities via high-voltage transmission grids to smaller distribution networks that served a huge number of users. PWC (2020), the widespread use of 5G communication networks will enable the Fourth Industrial Revolution's full potential to be fulfilled.

Unprecedented levels of connectivity will be made possible by 5G, which will upgrade 4G networks with five core functional drivers: high reliability/availability, large machine-type communications, ultra-reliable low latency communication, and efficient energy utilization. These distinguishing characteristics will revolutionize a variety of industries, including manufacturing, transportation, public services, and health.

Key parties must respond to critical questions to guarantee the widespread deployment of 5G networks. Mobile and telecommunications operators must assess appropriate business models, city managers and government regulators must decide whether and when to invest in 5G infrastructure, and residents must find ways to take advantage of all the advantages this technology has to offer while preserving the rights of the community (O'Halloran, 2019).

Only when all parties involved citizens, business, and government work together to find effective answers to these issues will the switch to 5G networks be successful.

2. OVERVIEW OF 5G NETWORKS

5G is the Fifth-generation of radio mobile networks after 1G, 2G, 3G and 4G. The mobile network is anticipated to drastically improve with 5G, enabling more connections and interactions. The possibility for numerous industries to increase their bottom line will be greatly increased by this network connectivity improvement.

By widely deploying 5G communication networks together with other connection options, the benefits of the Fourth Industrial Revolution and its associated new technologies will be fully realized. A wide range of options will become available as a result of 5G's major functional drivers, including improvements in service delivery, decision-making, and end-user experience (PWC, 2020).

A. 5G Ecosystem

According To PWC (2020), to make the most of the new, end-to-end network architecture of 5G and its associated functional drivers, the 5G Ecosystem Cycle was determined. It makes possible the long-term evolution of society and several industry sectors. The cycle is based on how all of the ecosystem's major components are interdependent with one another and how specific events must take place in each of them in order to start and keep the cycle moving. The 5G Ecosystem Cycle seeks to illustrate the necessity of stakeholder engagement and alignment across the ecosystem, including coordinated decision-making that will have an impact on the ecosystem's succeeding components.

The 5G network is a complicated system in which numerous players play numerous roles. The 5G ecosystem makes it possible for devices, connectivity, and IT infrastructure to all come together. Businesses have access to a variety of options thanks to the 5G ecosystem, including quicker time to market and the ability to develop better products and services.

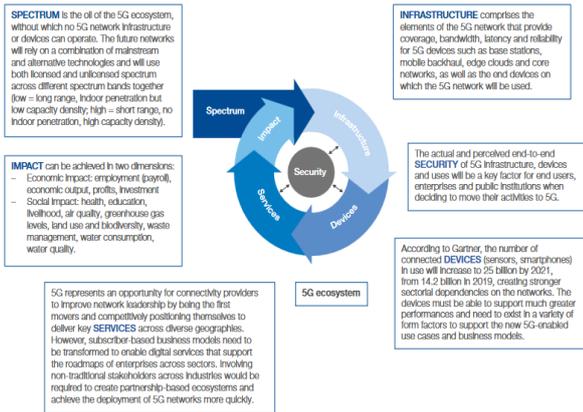


Figure 1. The 5G Ecosystem Cycle

B. 5G Functional Drivers

There are five key functional drivers of 5G that support certain technological applications. They are:

- i. Enhanced mobile broadband;
- ii. Ultra-reliable low latency communications
- iii. Security;
- iv. Massive machine-type communications;
- v. Power efficiency.

Functional driver	Description	Added value	Use cases
Enhanced mobile broadband (eMBB)	Faster connections, higher throughput and greater capacity (up to 10 Gbps)	Allows for an extension in cellular coverage into diverse structures (large venues) and the ability to handle a larger number of devices using high amounts of data	Fixed wireless access services, enhanced in building broadband service, real-time augmented reality service, real-time virtual and mixed reality service, crowded or dense areas services, enhanced digital signage, high-definition cloud gaming, public protection and disaster response services, massive content streaming services, remote surgery and telemedicine
Ultra-reliable low latency communication (uRLLC)	Reduced time for data from device to be updated and reach its target (1 ms compared to 50 ms for 4G)	Enables time-sensitive connections wirelessly	Autonomous vehicles, drones and robotic applications, health monitoring systems/telehealth, smart grid and metering, intelligent transportation, factory automation, remote operation, self-driving cars, mission-critical services (security and safety), high-definition real-time gaming
Security	Robust security properties, leading to high reliability and availability	Creates an ultra-reliable connection to support applications where failure is not an option	
Massive machine-type communications (mMTC)	Increased spectral efficiency plus small cell deployment	Allows for a large number of connections to support data-intensive applications	Asset tracking and predictive maintenance, smart cities/buildings/agriculture, Internet of energy/utility management, industrial automation, smart logistics (advanced telematics), smart grid and metering, smart consumer wearables, environmental management, intelligent surveillance and video analytics, smart retail
Power efficiency	Efficient power requirements for massive multiple-input, multiple-output (MIMO), small cell implementation	Leads to lower costs and enables massive Internet of things	

Figure 2. 5G functional drivers

C. Role of Private 5G Networks In Industry 4.0 & Beyond

As regulators provide businesses greater spectrum to build their own private 5G networks, private 5G networks have gaining popularity across the globe. Companies who want 5G capabilities to deliver their disruptive apps now have a progressive opportunity to do so. Smart manufacturing and the internet of things are now being driven by innovative digital change (Tanna, 2022).

High bandwidth and data rates can be provided by 5G private networks for extremely rapid connectivity. These networks also offer great dependability, scalability, and ultra-low latency of 1 ms. Bulk volumes of IoT-connected sensors and devices can be accommodated by them successfully. As a result, these networks are suitable for enterprises that need extremely low latency to handle vast networks of linked devices.

In addition to flawless communication, private 5G networks support a variety of applications. They assist with mission-critical wireless communication with essential infrastructure, business operations, and public safety. The foundation for smart factories and smart production is laid by 5G-enabled technologies, which also provide producers with enticing

advantages. These networks support use cases for cutting-edge technology including autonomous vehicles, collaborative mobile robotics, automated guided vehicle systems, augmented reality (AR), virtual reality (VR) headsets, and predictive maintenance, among others.

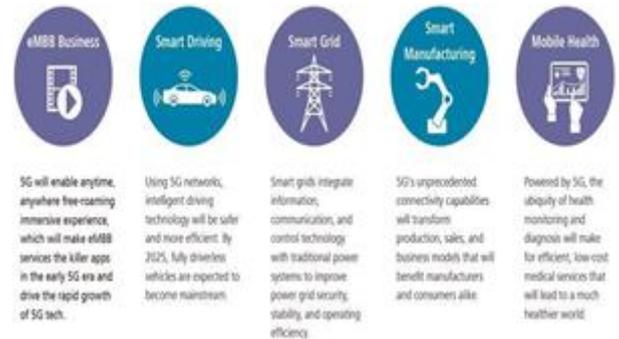


Figure 3. 5G Sectorial Digital Transformation

3. OVERVIEW OF INDUSTRY 4.0

The fourth industrial revolution, sometimes known as "Industry 4.0," envisions the digital transformation of the production, manufacturing, and allied industries. It denotes a new stage in the organization, control, and value generating procedures of the industrial value chain. The Industrial Revolution was sparked by industrial and machine production. There have been three stages thus far.

The introduction of steam power and production mechanization in the 18th century sparked the first industrial revolution. With the invention of electricity and the introduction of assembly lines, the Second Industrial Revolution got underway in the 19th century. In the latter half of the 20th century, partial automation employing computers and robots with memory-programmable controllers made way for the Third Industrial Revolution.

A. The Impact of Industry 4.0 Technology on Production

Real-time data about the entire production process is made available by Industry 4.0. The value chain of the organization is visible to the user. Production-related factors include the raw materials utilized, how they were supplied at various stages, where they came from, and the many tasks involved. It becomes simpler for the manufacturing organization to build plans for controlling the supply chain and increasing the organization's production rate by keeping track of the complete value chain and the production activities (Ghobakhloo and Fathi, 2019). To manage the production activities effectively, the distribution of resources and goods can be successfully regulated.

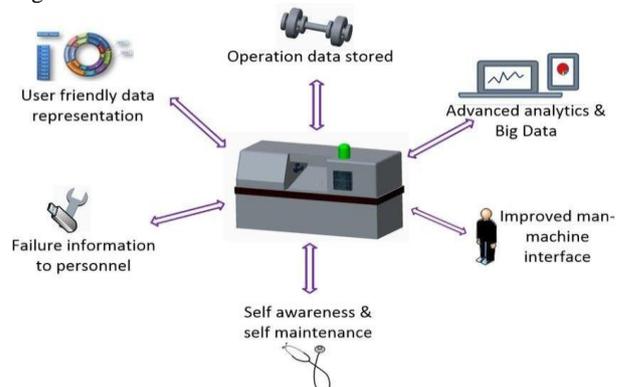


Figure 4. Industry 4.0 Production Transformation

B. Industry 4.0 Technologies

- **Internet of Things (IoT)** - IoT is the foundation of smart factories, which allow machines with sensors to communicate with other web-enabled equipment. This guarantees the gathering and analysis of enormous amounts of data to assist in making wise decisions.
- **Cloud-based computing** - Bulk data may be stored and analyzed more effectively thanks to the cloud. The supply chain, engineering, production, sales & distribution, and service are all connected and integrated.
- **Edge processing** - data processing takes place "at the edge," or where the data is created. By ensuring that data stays close to its source and minimizing latency, security threats are decreased
- **Digital twins** - virtual representations of manufacturing facilities, assembly lines, workflows, and supply networks. In order to enhance workflows and boost efficiency, they collect data from IoT devices, sensors, and other linked things.
- **AI and Machine Learning (ML)** - help make the most of the vast amounts of data gathered from diverse sources. It increases operational efficiency by facilitating the seamless automation of operations and business processes.



Figure 5. Industry 4.0 Technological Pillars

C. Benefits of Industry 4.0

The advantages that the technology provides make the role of 5G and its ROI prospects with Industry 4.0 important. Automation, decision-making, and manufacturing control are all improved by Industry 4.0 technologies. We are able to produce more and faster thanks to them, and they also open up chances for innovation and resource allocation that is both efficient and economical.

By reducing machine downtime and accelerating batch changes, they help increase productivity. Additionally, it encourages automated reporting and track-and-trace procedures. It also gets more effective to introduce new products.

Industry 4.0 technologies improve collaborative working and encourage knowledge exchange, whereas traditional manufacturing plants operate in silos with little interaction. Generally, Industry 4.0 has cumulative benefits cutting across several spheres. There include but are not limited to:

- Manufacturing benefits e.g. Improved Productivity, Flexibility and Agility
- Quality and compliance benefits e.g. Improved Product Quality, Easier Compliance
- Customer and patient benefits e.g. Better Customer Experience, Personalized Products

- Operational Benefits of Industry e.g. Reduces Costs, Improved Decision-Making, Increased Profitability



Figure 6. Industry 4.0 Opportunities

D. Challenges with Industry 4.0

Common roadblocks to digital transformation include:

- A lack of people or expertise in managing complex Industry 4.0 and 5G structures
- Concerns about cyber security
- Capital outlay
- Inadequate digital infrastructure
- Lack of understanding of digitalization and its uses



Figure 7. Industry 4.0 Challenges

4. RESULTS & FINDINGS

A. Industrial Advances

Three key ways that 5G will contribute to industrial advancements are as follows:

- Using predictive intelligence, it will be possible to conduct inspections more quickly and effectively;
- Improving workplace and worker safety; and
- Improving operational effectiveness.

By reducing carbon emissions and closing the digital gap, 5G has the potential to have an influence on the industrial sector.

5G for Industry Digitization

Due to industrial developments, 5G will likely be a key technology for addressing a number of issues caused by the rapid digitization of various industries. A wide range of societal use cases are supported by 5G, which offers an unrestricted, blazing-fast, dependable, and secure broadband experience. It will offer the networks and platforms needed to power Industry 4.0's digitalization and automation of industrial operations. It will facilitate the extensive adoption of vital communications services and enable the broad deployment of intelligent IoT. (GSMA, 2017).

In conclusion, 5G networks allow service providers to design virtual networks that are specific to the needs of applications like (Condon, 2017):

- Mobile broadband – communication, media and entertainment, and the Internet
- Machine-to-Machine (Massive IoT) – Retail, shopping, manufacturing
- Reliable low latency – Automobile, medical, smart cities

- iv. Critical Communications
- v. Others industry-specific services and energy

B. Social Impact

Of the 17 Sustainable Development Goals set forth by the UN, 5G can contribute to social progress in 11 crucial areas (SDGs). This value is primarily derived from improving infrastructure, advancing sustainable industrialization, and encouraging innovation. It also derives from improving health and well-being. In addition to fostering responsible consumption, sustainable cities and communities, and the advancement of fair employment and economic growth, 5G also has a significant social impact in these other key areas.

- i. 5G has the ability to contribute significantly to societal well-being through reduced potential injuries and fatalities
- ii. 5G is a key enabler to enhance infrastructure, promote sustainable industrialization and foster innovation.
- iii. Ultra-reliable low latency communication is the key defining driver of 5G that will realize socio-economic value.
- iv. The second-most defining driver of 5G is enhanced mobile broadband, mainly related to artificial intelligence, mixed reality and drone-based applications.

C. 5G maturity

- i. Drone-based apps, mixed reality, and artificial intelligence all heavily rely on improved mobile broadband.
- ii. A fundamental benefit of 5G that can be immediately realized is quicker image/video processing, which is supported by improved mobile broadband combined with reduced latency.
- iii. Low latency is essential for opportunities reliant on real-time machine learning, a feature that will eventually reach full maturity.

5. CONCLUSION

The industrial sector will continue to profit from the 5G revolution as its role expands. With its higher capacity, quicker speeds, and lower latency, 5G is anticipated to be the driver of innovation in the future industrial landscape. It has the capacity to provide new value for numerous sectors and social groups.

Due to its ability to enable previously unheard-of levels of connectivity, 5G will significantly contribute. With ultra-reliable low latency communication, extremely fast broadband, massive machine-type communications, and efficient energy use, it can upgrade 4G networks. These characteristics will transform a number of industries, including manufacturing, transportation, healthcare, and public services.

5G will significantly advance industry by improving workplace and worker safety; utilizing predictive intelligence for quicker and more efficient inspections; and increasing operational effectiveness. Overall, 5G may have an influence on the industry by closing the digital gap and reducing carbon emissions.

Strong coordination amongst stakeholders is required to make sure that the deployment of 5G will be accelerated and that its components and interdependencies are understood. The functional drivers of 5G provide technical support for many of the present instances, which are then activated through multi-stakeholder engagement. To address the issues preventing widespread 5G adoption globally and to take full advantage of the opportunities it will bring across sectors, regulators, industry associations, network operators, service/technology providers, and public-private partnership organizations must

engage in constant communication. In the future, it will become more crucial than ever to define frameworks and models for collaboration in order to start and maintain cooperation more successfully.

6. RECOMMENDATIONS

- More research and interventions are needed to improve cyber security in 5G and Industry 4.0.
- More human capacity must be developed to handle complex Industry 4.0 and 5G structures.
- Globally, adequate digital infrastructure must be set up to accommodate 5G and Industry 4.0.
- Greater awareness of digitalization and its applications is needed.

7. REFERENCES

- [1] GSMA. (2019). 5G for the Fourth Industrial Revolution <https://www.gsma.com/spectrum/wp-content/uploads/2019/05/1-Isabelle-Mauro-Director-Head-of-Telecoms-Digital-Communications-Industry-WEF.pdf>. Retrieved October 11, 2022
- [2] Derek O'Halloran. (2019). What you need to know about 5G <https://www.weforum.org/agenda/2019/12/what-you-need-to-know-about-5g/>. Retrieved October 11, 2022
- [3] WEF. (2020). The Impact of 5G: Creating New Value across Industries and Society https://www3.weforum.org/docs/WEF_The_Impact_of_5G_Report.pdf. Retrieved October 17, 2022
- [4] PWC. (2020). The Impact of 5G: Creating New Value across Industries and Society <https://www.pwc.com/gx/en/about/contribution-to-debate/world-economic-forum/the-impact-of-5g.html>. Retrieved October 17, 2022
- [5] Attaran, Mohsen & Attaran, Sharmin. (2020). Digital Transformation and Economic Contributions of 5G Networks. *International Journal of Enterprise Information Systems*. 16. 58-79. 10.4018/IJEIS.2020100104.
- [6] Bhakti Tanna. (2022). Role of Private 5G Networks in Industry 4.0 & Beyond. <https://www.stl.tech/blog/role-of-private-5g-networks-in-industry-4-0-beyond/>. Retrieved October 25, 2022
- [7] Chacon, Maan, (2022). Private 5G Networks and the Fourth Industrial Revolution. <https://www.iotforall.com/podcasts/e203-private-5g-networks-fourth-industrial-revolution>
- [8] GSMA. (2017). The 5G era: age of boundless connectivity and intelligent automation. GSM Association. <https://www.gsma.com/latinamerica/resources/the-5g-era-age-of-boundless-connectivity-and-intelligent-automation/>. Retrieved October 31, 2022
- [9] Condon, S. (2017). Report: By 2035, 20 percent of 5G's economic impact will be in automotive. Between the Lines. <https://www.zdnet.com/article/report-by-2035-20-percent-of-5gs-economic-impact-will-be-in-automotive/> Retrieved October 31, 2022
- [10] Ghobakhloo, M. and Fathi, M., 2019. Corporate survival in Industry 4.0 era: the enabling role of lean-digitized manufacturing. *Journal of Manufacturing Technology Management*.

A Survey of Artificial Intelligence in Cyber Security

Duncan Nyale
School of Computing and Mathematics
The Co-operative University of Kenya
Nairobi, Kenya

Shem Mbandu Angolo
School of Computing and Mathematics
The Co-operative University of Kenya
Nairobi, Kenya

Abstract: Artificial intelligence (AI) and cyber security are two emerging technologies in the modern world. Machine learning (ML) models serve as the cornerstone of AI. Access control, user authentication, user behaviour analysis, spam, malware, and botnet identification are all areas where AI is crucial. The security issues of today, however, are many. Users now face substantial security threats due to the increasing use of apps like WhatsApp and Viber, social media, mobile devices, cloud computing, and social media. We will explain how artificial intelligence (AI) can be used to handle cyber security concerns and cyber threats in this essay. Since the past decade, the field of cyber security has expanded significantly. Thus, both the number of applications and the number of risks are continuously increasing. Artificial intelligence's applications in cyber security are covered in this essay. With a primary focus on studies between 2018 and 2022, the study technique involved online desk research.

Keywords: Artificial Intelligence, Cyber Security, Cyber-threats, Block chain

1. INTRODUCTION

By incorporating artificial intelligence into cyber security systems, the rising and evolving daily cyber security threat that faces multinational corporations can be lessened. As processing power, storage capabilities, and data collecting expand, machine learning and artificial intelligence (AI) are integrated more broadly across sectors and applications than at any other time in recent memory.

The use of security monitoring tools across all spheres of communication has resulted in the generation of huge amounts of data. Usually, this data contains information about suspicious activities within networks and applications. Leveraging on AI techniques, models can be trained to scan for unknown malware or zero-day exploitations based on attributes and behaviour of packets traversing the networks hence reducing the amount of time taken to identify attacks[1].

Artificial intelligence (AI) and cyber security are two technologies that are advancing in the modern world. Cyber security encompasses both network and communication infrastructures as well as the interactions of human actors with these systems[2]. Global digital networks can interact inside this space. There are many different dangers and sectors that fall under the umbrella of cyber security. These include, but are not limited to, malware analysis, intrusion detection, web application security, social network security, and others[3].

2. METHODOLOGY

Thematic literature review methodology was used in this study. Utilizing keywords and keyword combinations relating to the subject, relevant materials were retrieved from the following databases: Google Scholar, Science Direct, Research Gate, and Academia. Second, because this study seeks to offer an overview of recent advancements of Artificial Intelligence applications in the field of cyber security, only related literatures published during the previous five years were taken into consideration. Manuscripts

published later than five years but with unique techniques were also picked.

3. ROLE OF ARTIFICIAL INTELLIGENCE IN CYBERSECURITY

A. Artificial Intelligence

Artificial intelligence is a technique for teaching a computer, a robot that is controlled by a computer, or a piece of software to think critically, much like an intelligent person might. AI is achieved by researching how the human brain works, as well as how people learn, make decisions, and collaborate while attempting to solve a problem, and then using the findings of this research as the foundation for creating intelligent software and systems.

Commonly, people define intelligence as the capacity to acquire knowledge and use knowledge to reason about difficulties. Intelligent machines will soon take over many human functions in the near future. The study and creation of intelligent computers and software that can reason, learn, gather information, communicate, operate, and perceive objects are known as artificial intelligence. In 1956, John McCarthy first used the phrase to describe a subfield of computer science that focused on teaching computers to act like people. Understanding computing is what enables perception of reason and behaviour. Artificial intelligence differs from psychology in that it places a greater emphasis on computation and from computer science in that it places a greater emphasis on perception, reasoning, and action. It improves the intelligence and utility of machines[4]. Ever since the first triumph of the 480 chipset computer known as the Deep Blue over Garry Kasparov on 11th May, 1997[5], AI has gotten closer and closer to passing the Turing's test.

B. The development of AI in cyber security

As registering power, information accumulation, and capacities increase, machine learning and Artificial Intelligence (AI) are being connected more thoroughly than ever before across organizations and applications. This vast

collection of data is valuable food for AI, which can sift and examine everything gathered to discover novel patterns and delicate features. This means that in terms of cyber security, new initiatives and flaws can be quickly identified and studied to help prevent additional attacks. It may lighten some of the burden on human security "partners." When a task is necessary, they are warned, but they also have the option of devoting their time to more creative and fruitful tasks. Taking into account the top security expert in your association is a useful partnership. If you prepare your machine learning and artificial intelligence algorithms using this star representative, the AI will be just as intelligent as your star employee.

Currently, if you take the time to create your machine learning and artificial intelligence programs with your 10 best employees, the outcome will be a solution that is as intelligent as your 10 best employees arranged together. Additionally, AI never takes a day off[6].

C. What Applications Does Artificial Intelligence Have for Cyber security?

In some of the following domains of cyber security solutions, artificial intelligence (AI) is already being applied or is actively being explored, i.e. Gmail uses artificial intelligence to detect and stop unwanted spam and fraudulent emails. Every time a user clicks on an email message, whether it is spam or not, they are helping to train Gmail's artificial intelligence to recognize spam in the future. There are millions of Gmail users worldwide. Because of this advancement, artificial intelligence is now capable of detecting even the subtlest spam emails that try to pass as "regular" emails.

- **Fraud detection:** Using Decision Intelligence deployed by MasterCard, an artificial intelligence-based fraud detection system that uses algorithms based on anticipated consumer habits is used to identify fraudulent transactions. In order to evaluate if a purchase is odd, the system looks at the customer's typical buying habits, the vendor, the transaction's location, and many more intricate algorithms.

- **Botnet Detection:** A particularly challenging field, botnet detection often relies on proxy server timing analysis and pattern recognition. Since botnets are typically controlled by a master script of instructions, a large number of "users" doing the same searches on a website are typically included in a botnet attack. This could involve network vulnerability scans, other breaches, and unsuccessful login attempts (a botnet brute force password assault). It is quite challenging to convey in a few lines the incredibly complex role that artificial intelligence plays in botnet identification.

These are only a few of the applications for artificial intelligence in cyber security.

The usefulness of artificial intelligence in the area of cyber security is currently supported by a significant number of research articles that offer compelling facts.

The majority of research indicate that between 85 and 99 percent of attempts are successful in recognizing cyber-attacks. Dark Trace, an artificial intelligence development company, claims to have a success rate of 99 percent and already has thousands of customers worldwide[7].

D. AI on Network Attack Detection

Through AI models, cyber attacks on networks can be detected early[1]. Three network attack detection classifiers that use decision tree, support vector machines and a hybrid between the two have been proposed[8, 9]. Since there propositions, a lot of models have been developed for the same[10-14]. The significant amounts of datasets generated by networking monitoring tools, AI models can continuously be trained in both attributes and signatures of the malicious activities on the network.

E. Benefits of AI in Cyber Security

Reviewing the benefits of artificial intelligence in the context of cyber security finds that organizations who use it reap huge rewards. This is clear from the fact that two out of every three firms saw an increase in ROI on cyber security technologies. For instance, Siemens AG, a pioneer in global electrification, automation, and digitalization, used Amazon Web Services (AWS) to build an AI-based, quick, autonomous, and incredibly elastic platform for its Siemens Cyber Defense Center (CDC). The AI that was deployed could predict 60,000 possible assaults every unit of time. Due to the AI that was implemented, this capacity may be managed by a team of fewer than 12 people without having an adverse effect on system performance. AI in cyber security enables organizations to analyze and reapply historical danger patterns to identify new risks. This saves time and effort when locating incidents, looking into them, and eliminating threats. The cost of identifying and responding to breaches was reduced by AI, according to about 64% of administrators. A quick response is crucial for avoiding cyberattacks. The average cost decrease for corporations is around 12%. Because the environment of cyber security is fast shifting from identification, manual response, and mitigation to automated mitigation, AI presents prospects for cyber security. AI is able to recognize intricate and innovative changes to attack extensibility [15].

F. Issues with AI in Cyber Security

- i. **Cyber threats:** Nowadays, hackers have too much access to your data and privacy. If precautions are not followed, they can easily track your whereabouts and hack your personal information.
- ii. **Job loss:** Artificial intelligence is viewed as a threat since some studies indicate that a significant portion of the workforce will be replaced by AI apps and machinery.
- iii. **The third AI worry** is that machines will start to rule over people. This issue has previously been covered in numerous books and movies. It is necessary to take action to stop this from happening.
- iv. **Cost-effectiveness:** Because some AI services can be prohibitively expensive, not everyone can benefit from them.
- v. **AI is not well known** since not everyone is interested in working with and willing to learn new contemporary technology.

G. Future Perspectives

All sources believe that spending on cyber security will rise in the coming years as businesses become more aware of the hazards they face online. For instance, according to the Technology Industry Association (TIA), US spending will reach \$63.5 billion in three years, or 0.35 percent of GDP. According to Gartner Inc., global spending will increase by 8.2%. The US \$407 billion potential net benefit of block chain technology is the largest in the world.

The largest market opportunity (US\$962 billion) is in the management of product inventories, also known as provenance, which has changed the supply chains of many companies' operations. Block chain technology may help companies, from those in the heavy industry, like mining, to those in the fashion industry, in response to the public and investors' growing interest in sustainable and ethical sourcing. In order to help decrease fraud and identity theft, banking and financial institutions use strategies including the use of digital crypto currencies and the promotion of cross-border and remittance digital payments[7].

4. THEORETICAL STUDY REGARDING CYBER SECURITY & ARTIFICIAL INTELLIGENCE

A. Cyber attack

A cyber-attack is when someone enters a computer, computing system, or computer network without authorization with the goal of causing harm. Cyber-attacks try to modify, alter, block, erase, or steal the data stored within computer systems in order to control, disrupt, disable, or destroy them.

- 1) The lifespan of a cyber-attack: An attacker first conducts a thorough reconnaissance to identify the network's weak points. Less secure computers, cell phones, IOT devices, routers, and other network equipment may all be susceptible locations. By using cyber-espionage, phishing emails, and other techniques, the attacker takes advantage of these vulnerabilities to use malicious codes or applications. Once the initial breach is done, the attacker maintains control over that [16]. On gain a firm footing, the attacker installs a backdoor or downloads malware to the infected system. The attacker never leaves the area; instead, he makes care to remain present at all times. As a result, the attacker succeeds in his task and keeps silent until a new mission is ordered.
- 2) Categories of online attacks
 - a) Denial of service (DOS): This type of attack prevents legitimate users from accessing information system hardware or network resources on a network that is operated through the internet. Examples include "Lock, Land, Neptune, pod, smurf," and "teardrop."
 - b) Remote to local attack (R2L): An attacker launches a Remote to Local attack (R2L) to take control of a victim machine throughout the entire network [17]. Examples include imap, multihop, ftp-write, and guess-password.

- c) A user to root attack (u2r) is typically started to gain root privileges when a user has legitimate access to a local machine [9]. Examples include buffer overflow, load modules, perl, rootkits, ps, sqlattacks, and x terms.
- d) Probe: A probe is a program or other device that is put at a crucial junction in a network in order to track or gather information about network activity [16]. For instance, nmap, portsweep, Satan, and ipsweep

B. Cyber Defense

Cyber defense refers to the early detection of malicious online activity and the implementation of countermeasures. Additionally, it describes ways to stop, thwart, and combat online attacks[18].

C. Machine Learning

Machine learning refers to procedures and formulas that extrapolate from historical information and experiences. In this process, it forecasts likely future outcomes. As a result, machine learning is a collection of mathematical methods applied to computer systems that enable data inference, pattern recognition, and information mining.

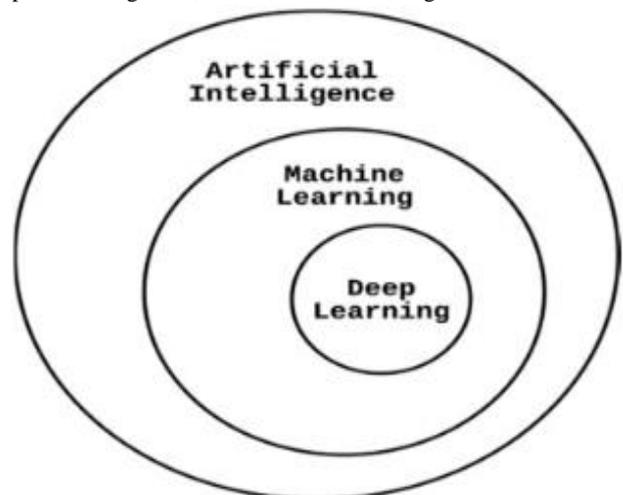


Fig. 1. A representation of machine learning and deep learning in artificial intelligence[18].

Algorithmic answers to challenging problems are suggested by artificial intelligence (AI). AI's basic building blocks include machine learning. Hardcoded decision-making algorithms for artificial intelligence that are not machine learning [10] are sometimes known as rule engines.

D. MLP (Multi-Layer Perceptron)

Multilayer perceptrons, or MLPs, are a particular kind of feed forward artificial neural network (ANN). The term "MLP" is vague; it could apply to any feed-forward ANN or to networks made up of numerous layers of perceptrons (with threshold activation) The term "vanilla" neural networks is often used to describe multilayer perceptrons, particularly ones with a single hidden layer.

An MLP has an input layer, a hidden layer, and an output layer, which together make up at least three levels of nodes.

Except for the input nodes, every node is a neuron with a nonlinear activation function. MLP employs the supervised learning method of back propagation during training. MLP differs from a linear perceptron due to its multiple layers and non-linear activation. It can distinguish between data that isn't linear and data that is.

5. CONCLUSION

In this essay, we looked at the significance of artificial intelligence for online safety as well as its different drawbacks and how to reduce them. Despite its limitations, artificial intelligence still plays a big part in cyber security. Artificial intelligence (AI) will support the advancement of cyber security by helping to overcome the disadvantages.

In this research, cyber security and AI, two rising technologies, have been combined. Attackers always opt to surprise the defence before striking. Therefore, using current technology is your best tool for pulling off a surprise. As a result, it is anticipated that this cyber protection technique will be extremely successful.

6. REFERENCES

- [1] L. F. Sikos, *AI in Cybersecurity* vol. 151: Springer, 2018.
- [2] B. B. Gupta and M. Sheng, "Machine Learning for Computer and Cyber Security," ed: CRC Press. Preface.
- [3] C. Chio and D. Freeman, *Machine learning and security: Protecting systems with data and algorithms*: O'Reilly Media, Inc., 2018.
- [4] R. Kumar, "Artificial Intelligence: A Path to Innovation," *International Journal of Scientific Research in Science and Technology (IJSRST)*, 2017.
- [5] F.-h. Hsu, "IBM's deep blue chess grandmaster chips," *IEEE micro*, vol. 19, pp. 70-81, 1999.
- [6] J. Podishetti and K. Anjaiah, "Role of Artificial Intelligence in Cyber Security," *International Journal of Research in Advanced Computer Science Engineering, Volume*.
- [7] I. A. Mohammed, "Artificial Intelligence For Cybersecurity: A Systematic Mapping of Literature," *International Journal of Innovations In Engineering Research and Technology [IJERT]*, vol. 7, 2020.
- [8] A. Abraham and J. Thomas, "Distributed intrusion detection systems: a computational intelligence approach," in *Applications of information systems to homeland security and defense*, ed: IGI Global, 2006, pp. 107-137.
- [9] S. Peddabachigari, A. Abraham, C. Grosan, and J. Thomas, "Modeling intrusion detection system using hybrid intelligent systems," *Journal of network and computer applications*, vol. 30, pp. 114-132, 2007.
- [10] V. Kanimozhi and T. P. Jacob, "Artificial intelligence based network intrusion detection with hyper-parameter optimization tuning on the realistic cyber dataset CSE-CIC-IDS2018 using cloud computing," in *2019 international conference on communication and signal processing (ICCSP)*, 2019, pp. 0033-0036.
- [11] M. H. Shahriar, N. I. Haque, M. A. Rahman, and M. Alonso, "G-ids: Generative adversarial networks assisted intrusion detection system," in *2020 IEEE 44th Annual Computers, Software, and Applications Conference (COMPSAC)*, 2020, pp. 376-385.
- [12] D. L. Marino, C. S. Wickramasinghe, and M. Manic, "An adversarial approach for explainable ai in intrusion detection systems," in *IECON 2018-44th Annual Conference of the IEEE Industrial Electronics Society*, 2018, pp. 3237-3243.
- [13] K. Jiang, W. Wang, A. Wang, and H. Wu, "Network intrusion detection combined hybrid sampling with deep hierarchical network," *IEEE Access*, vol. 8, pp. 32464-32476, 2020.
- [14] A. Kim, M. Park, and D. H. Lee, "AI-IDS: Application of deep learning to real-time Web intrusion detection," *IEEE Access*, vol. 8, pp. 70245-70261, 2020.
- [15] S. B. Atiku, A. U. Aaron, G. K. Job, F. Shittu, and I. Z. Yakubu, "Survey On The Applications Of Artificial Intelligence In Cyber Security," *International Journal of Scientific and Technology Research*, vol. 9, pp. 165-170, 2020.
- [16] L. Mohammadpour, M. Hussain, A. Aryanfar, V. M. Raee, and F. Sattar, "Evaluating performance of intrusion detection system using support vector machines," *International Journal of Security and Its Applications*, vol. 9, pp. 225-234, 2015.
- [17] S. Brindasri and K. Saravanan, "Evaluation of network intrusion detection using Markov chain," *International Journal on Cybernetics & Informatics (IJCI)*, vol. 3, pp. 11-20, 2014.
- [18] S. F. DeAngelis, "Artificial Intelligence: How Algorithms Make Systems Smart," *Wired*. Available online at: <https://www.wired.com/insights/2014/09/artificial-intelligence-algorithms-2/>(accessed February 2, 2022), 2014.

A Survey of Contemporary and Emerging Research Methods in Information Systems Research

Duncan Nyale
School of Computing and
Mathematics
The Co-operative University of
Kenya
Nairobi, Kenya

Salome Mwangi
School of Computing and
Mathematics
The Co-operative University of
Kenya
Nairobi, Kenya

Simon Karume
School of Computing and
Mathematics
The Co-operative University of
Kenya
Nairobi, Kenya

Abstract: This paper's major goals are to present an overview of the current research trends in information systems (IS), investigate the causes of those trends, evaluate the relevance and effectiveness of those trends, and then suggest strategies to enhance IS research. The study builds a foundation for understanding information systems research. The concepts of positivism, interpretivism, qualitative, and quantitative research are discussed in this paper along with current trends in information system research methodologies. It also highlights the distinctions between qualitative and quantitative approaches and provides justification for the use of case studies in information systems. The study's methodology involved online desk research, with a primary focus on studies between 2018 and 2022.

Keywords: Information, Information Systems, Interpretive research, Information technology, Computer Based Information System, research, Information Systems research

1. INTRODUCTION

Information System

A formal sociotechnical organizational framework created to gather, process, store, and distribute information [10]. Task, people, structure (or roles), and technology make up information systems from a sociotechnical standpoint. Information systems can be characterized as the integration of elements for the gathering, storing, and processing of data, where the data is utilized to produce informational products, knowledge-contributing works, and digital goods that aid in decision-making.

Computer Based Information System

An integrated system of parts for gathering, storing, and processing data as well as for delivering information, knowledge, and digital goods [6].

Research

The systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions

Purpose of information systems research

Examining the creation, application, and effects of digital information and communication technology is the focus of the field of information systems research. i.e.

- i. A concentration on digital technologies, or technologies that rely on digitization.
- ii. The investigation of production, application, and effects.

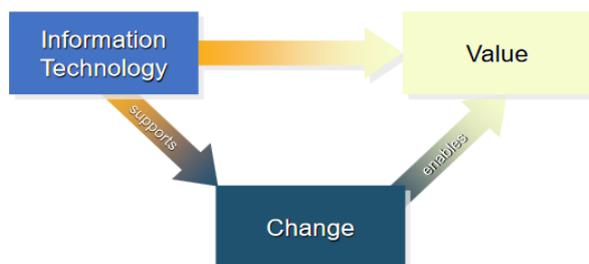


Figure 1. The Focus of IS Research

Methods for Conducting Information System Research

- i. Information technology, software engineering, and computer science scholars research the technical and computational properties of digital technology as a whole.
- ii. Individuals' exposure, use, appropriation, and general behaviors [within digital technology domains] are studied by behavioral, cognitive, and psychological scientists.
- iii. Organizational science, management, and business scholars investigate how corporate environments shape and are shaped by digital technology.
- iv. Economists investigate the broad effects of digital technology diffusion and innovation on organizations, markets, and societies.

Research Personas in Information Systems

A. Theoretical Scientist

Evolves theory, for example developing a model to explain the evolution of sustainability projects using Information Systems

B. Experimental Scientist

Primarily evaluates theory, such as developing and assessing the effects of ontological properties of certain traits on behavior

C. Engineer

Applies theory to the creation of artifacts, such as finding ideas for improving corona dashboards by using state-tracking theory

Varieties of research

A. Conceptual research

Focuses on analyzing a current issue without making any promises about potential (technologically driven) remedies.

B. Formal research

Focuses on formulating ideas in mathematical terms (to avoid any ambiguity regarding their interpretation) and giving

theorems with supporting evidence to shed further light on these ideas

C. Technological research

Focuses on creating complex software artifacts to demonstrate the viability of ideas and to analyze the relative merits and shortcomings of alternative architectural philosophies, such as Workflow Systems (YAWL) or Process Mining (Celonis)

D. Experimental research

Usually examines a small number of characteristics of a phenomenon (such as a characteristic of a technology, a person, or a process), and does so in a controlled environment. experiments in physics or medicine, for instance.

E. Empirical research

Sets out to investigate occurrences in the real world in order to develop or support ideas regarding how the phenomena came to be. can be founded on case studies, polls, action research, grounded theory, or other techniques. For instance, models of success factors and technology acceptance

2. PROBLEM STATEMENT

Information systems (IS) have been developing for more than three decades. Although various schools of thought have developed and even become well-established, there have been relatively few historical assessments of research paradigms and methodology [7]. For the field of information systems to advance, theory must be applied effectively. However, little is known about the theory underpinning Information Systems (IS) research [8]. A framework and method for social science study that is dedicated to philosophical and methodological approaches to comprehending social reality is called interpretive research. For the analysis and design of information systems, interpretive research designs are essential [9]. There is a need to conduct studies on current and emerging research methods in information systems research in order to propose efficient research paradigms, plans, and strategies in information systems due to the lack of foundational research, effective theory application in information systems, and interpretive research.

3. RESEARCH OBJECTIVES

- i. To learn about the most recent developments in information systems research
- ii. To identify the factors impacting the current directions of information systems research.
- iii. To assess the effectiveness of the existing directions in information systems research.
- iv. To make suggestions for enhancing information systems research

4. RESEARCH QUESTIONS

- i. What are the most recent information systems research trends?
- ii. What are the variables impacting contemporary information systems research trends?
- iii. How effective are the present research trends in information systems?
- iv. What steps can be taken to enhance information systems research?

5. RESEARCH METHODOLOGY

Thematic literature review methodology was used in this study. Utilizing keywords and keyword combinations relating to the subject, relevant materials were retrieved from the following databases: Google Scholar, Science Direct, Research Gate, and Academia. Second, given the goal of this article is to provide an overview of current research trends in information systems, only pertinent literatures published during the last five years were taken into account. The selection process included manuscripts with unique techniques but published after five years.

Information Systems, Trends in Information Systems, Trends in Information Systems Research, Current Trends in Research, Current Trends in Information Systems Research, Interpretive Research, Information Technology Research, Positivism Research, Interpretivism Research, Researching qualitatively versus quantitatively, qualitative and quantitative research distinctions, case studies for information systems, case studies for information systems research, are some examples of search terms that were used to retrieve studies from the search areas.

6. LITERATURE REVIEW

In this section, research trends and methodologies are critically analyzed. It should be mentioned that selecting an effective research strategy for information systems is a challenging procedure that takes the research's goal into account, among other things.

A. Positivism

During the Enlightenment, Comte extensively popularized the positivist approach, commonly known as the scientific approach [1]. The strategy is predicated on the notion that there is a single, observable, quantifiable concrete reality. In the course of conducting research, it emphasizes experimentation, observation, control, measurement, dependability, and validity [1], [2].

On a metaphysical level, positivism holds that all phenomena under study have a single reality that is independent of the perspective of the researcher. The researchers' only responsibility in this situation is gathering and analyzing data. [1].

Positive epistemology maintains that empiricism is the preferred method of inquiry. In this method, research proceeds objectively through hypotheses and deductions. It contends that generalizable knowledge should be sought for and should permit verification or falsification. In order to determine things objectively, positivism employs quantitative techniques like structured questionnaires, surveys, and other statistical data [1], [2].

B. Interpretivism

According to the interpretive perspective, reality is arbitrary, layered, and socially produced. Since interpretive research is realistic from an ontological perspective, it is best investigated in the context of its social and historical setting [1], [2].

According to the interpretive research epistemology, humans build knowledge as they make sense of their experiences in and with the world. As a result, the researcher participates in the research, interprets the data, and as a result, neither the researcher nor the research can be objective [1].

An emphatic grasp of how norms and values affect perception and action is made possible by the interpretive approach, which offers a strong, consistent logical structure [2].

C. Comparison between positivism and interpretivism

The two approaches can be compared as discussed in Table 1 below

Table 1: Comparison between Positivism and interpretivism

Positivism	Interpretivism
Relationship between society and the Individual	
Society shapes the individual Society consists of social facts which exercise coercive control over individuals Peoples actions can be explained by the societal norms they have been exposed to through socialism	Individuals have consciousness and are not just puppets who react to external social forces as positivists
General Focus of social research	
The point of research is to uncover the laws that govern human behavior just as scientists have discovered the laws that govern the physical world Prefer quantitative methods which allows the researcher to remain detached from the respondents	The point of research is to gain in-depth insight into the lives of the respondents to gain an emphatic understanding of why they act in the way they do. Prefer qualitative methods which allow for close interaction with the respondents
Preferred research methods	
Quantitative Requires research to be valid, reliable and representativeness	Qualitative Prepared to sacrifice reliability and representative for greater validity

D. Qualitative approach

A "naturalistic, interpretive multimethod science," qualitative research involves gathering and evaluating non-numerical data to comprehend certain research topics [3]. In order to analyze social and cultural phenomena, research relies on non-numerical first-hand data collected from observation, interviews, questionnaires, and focus groups. Data gathered using this methodology has a significant capacity for revealing study complexity [3, 4]. There are five methods for conducting qualitative research on information systems [3], [5];

- Grounded theory, which entails data gathering for the formulation of new theories

- Ethnography, which entails direct and active observation to fully comprehend social and cultural processes
- Narrative research, which entails conceiving and examining the experiences of a people as they are expressed in written form. Its fundamental objective is to have a thorough understanding of the meaning that individuals attribute to their experiences and perceptions.
- Phenomenological study, which entails examining phenomena through people's actual experiences in an effort to comprehend and characterize the fundamental nature of that specific phenomenon.
- Action research, a participative and cooperative methodology that connects theory and practice to promote social change.

E. Quantitative approach

In a quantitative research approach, numerical data is gathered and analyzed to describe a phenomenon, discover correlations, or test hypotheses. To collect numerical data from a population sample, this method uses survey designs and experiments [3], [4]. In order to manage and explain a phenomenon, this technique focuses on the measurement of "how many," "how often," and "to what extent" [4]. Statistical principles are critically important for the examination of quantitative data.

F. Comparison between Quantitative and Qualitative approach

The use of qualitative and quantitative methods can coexist. As shown in tables 2 and 3, respectively, they can be compared in terms of concepts, processes, and analysis as well as strengths and weaknesses [4].

Table 2: Strengths and weaknesses of qualitative and quantitative research

Method	Strength	Weaknesses
Qualitative	The qualitative analysis allows a complete, rich and detailed description	Qualitative data is difficult to analyze and needs a high level of interpretive skills
	Can be faster when compared to quantitative methods	Good chance of bias
	Does not reduce complex human experiences to numerical form and allows a good insights into a person's experiences and behavior	Hard to draw brief conclusions from qualitative data
	Qualitative methods can be	Qualitative data faces difficulties in terms

	cheaper than quantitative research	of
	Ambiguities, which are inherent in human language can be recognized in the analysis	Low level of accuracy in terms of statistics
Quantitative	Quantitative analysis allows for the classifying of features, counting them, and constructing more complex statistical models in an attempt to explain what is observed.	Pictures of data which emerge from quantitative analysis lacks richness of details compared with data from qualitative analysis reduced to numerical form
	Findings can be generalized to a larger population	Quantitative implementation slow, and needs time compared with qualitative
	Allows researchers to analyze more easily because quantitative data is in numerical form	Can be expensive
	Provides a higher level of accuracy	Low response rates
	Compare measures of dispersion	Not simple to implement
	Allows to present analysis graphically	Quantitative always requires computer analysis

Table 3: Comparison between qualitative Research and Quantitative Research

Qualitative Analysis	Quantitative Analysis
The language is informal, and the method is frequently inductive.	Deductive reasoning and formal language are used.
may be quicker and less expensive than quantitative research	May be more expensive and comparatively slower than qualitative
Concepts take the shape of taxonomies, themes, and motifs.	Concepts take the shape of unique variables.
As the analysis moves forward, themes or generalizations are drawn	As the analysis moves on, statistics, tables, or charts are used.

from the evidence and the facts are organized to provide a clear picture.	
Procedures are specific, and replication is challenging	Replication is presumed and procedures are standardized.

7. FINDINGS

- i. Qualitative research, using positivism or interpretivism methods depending on the situation, is typically favored in information systems research.
- ii. Factors influencing research in IS include:
 - Research Focus e.g. on digital technologies or development
 - Research Characters e.g. Theoretical Scientist or Engineer
 - Research Type e.g. Conceptual research or Technological research
 - Research Domain e.g. information technology, software engineering, and computer science or organizational science, management, and business study
- iii. While positivist quantitative research is the least effective, interpretive qualitative research is the most successful research trend in information systems.
- iv. Interpretivism is suggested as the ideal paradigm for doing information system research since it is in line with the ideas and tenets of information system analysis, design, and application. Since information systems were developed by people for people, they must

8. CONCLUSION

Researchers in the field of information systems (IS) have investigated a variety of research approaches; each methodology has its own presumptions, approach to gathering data, and procedures for achieving the goals of the study. The selection of the most appropriate approach for data gathering and analysis is at the heart of research methodology. On the other hand, research technique is a method for concentrating on learning about issues and coming up with sensible answers. This report provided a summary of information systems research methodologies, including the examination of models for interpretative information systems research. The study then discussed how positivism, interpretivism, and interpretive IS research differ from qualitative method and quantitative approach while also highlighting both types' advantages and disadvantages.

9. REFERENCES

- [1] J. Scotland, "Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms," *English Lang. Teach.*, vol. 5, no. 9, pp. 9–16, 2012, doi: 10.5539/elt.v5n9p9.
- [2] W. Chen and R Hirschheim, "Chen, Hirschheim - 2004 - A paradigmatic and methodological examination of information systems research from 1991 to 2001.pdf," *Wiley Online Libr.*, pp. 197–235, 2004, [Online]. Available: <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2575.2004.00173.x/full>

- [3] M. R. (Ruth) De Villiers, “Models for Interpretive Information Systems Research, Part 2,” *Res. Methodol. Innov. Philos. Softw. Syst. Eng. Inf. Syst.*, pp. 238–255, 2012, doi: 10.4018/978-1-4666-0179-6.ch012.
- [4] M. Al Kilani and V. Kobziev, “An Overview of Research Methodology in Information System (IS),” *OALib*, vol. 03, no. 11, pp. 1–9, 2016, doi: 10.4236/oalib.1103126.
- [5] E. J. Davidson, “Information Systems and Qualitative Research,” *Inf. Syst. Qual. Res.*, 1997, doi: 10.1007/978-0-387-35309-8.
- [6] Vladimir Zwass, "information system" <https://www.britannica.com/topic/information-system>. Accessed 07th Nov 2022
- [7] Chen, Wenshin and Hirschheim, Rudy (2004) A Paradigmatic and Methodological Examination of Information Systems Research from 1991 to 2001. *Information Systems Journal*, 14 (3). pp. 197-235. ISSN 1350-1917
- [8] Lim, Sanghee; Saldanha, Terence J.V.; Malladi, Suresh; and Melville, Nigel P. (2013) "Theories Used in Information Systems Research: Insights from Complex Network Analysis," *Journal of Information Technology Theory and Application (JITTA)*: Vol. 14: Iss. 2, Article 2. Available at: <https://aisel.aisnet.org/jitta/vol14/iss2/2>
- [9] Lisa M. Given, "Interpretive Research". <https://methods.sagepub.com/reference/sage-encyc-qualitative-research-methods/n235.xml> . Accessed 07th Nov 2022
- [10] Piccoli, Gabriele & Pigni, Federico. (2016). *Information Systems for Managers*.