



ANALYSIS ON APPLICATIONS OF ARTIFICIAL INTELLIGENCE FOR E LEARNING SYSTEM

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ABSTRACT

Technological advancements have far-reaching consequences for the evolution of computing, networking, and the Internet as a whole. Artificial intelligence (AI) is a product among many others. The world's reliance on artificial intelligence is expected to grow. Research into the use of AI in e-learning has exploded in popularity in recent years, as more and more businesses recognise its potential as a vital tool for facilitating online education. Technology education, STEAM, augmented reality (AR) apps, online learning, and many more areas have all recognised the growing significance of online education over the past few decades. Understanding the current condition of online education is necessary for properly exploring research trends in this area. In this study, we introduce a novel idea for intelligent e-learning systems, in which an e-learning platform and its user engage in a two-way conversation. There is no doubt that artificial intelligence (AI) and its applications in the field of e-learning have been instrumental in elevating the level of intelligence present in e-learning resources and methods. For the better part of the previous two decades, the internet has been utilised to enhance such educational practises as distance learning, online collaboration, resource sharing, and promotion of active learning. For the sake of lifelong learning and to ensure compatibility with other educational management operations, many universities and educational institutions throughout the world now offer online services like admissions and virtual (online) learning environments.

Key words: E-Learning, Artificial Intelligence, Online learning, Learning Environment.

1. INTRODUCTION

1.1 Introduction

Today e-learning system plays an essential role in the education system. Technology integration in teaching helps to teach content-based curriculum effectively and efficiently to build confidence among students. Personalized learning systems focus on learning behavior, interest, and design curriculum according to learners' ability and basic knowledge. It's an adaptable approach to education that caters to each student's specific requirements. The personalized learning approach optimizes the needs of each learner. For an effective education system, it is necessary to understand learners and develop a plan that copes up with the individual learning needs and the interest of students". An intelligent Tutor system is an expert system to monitor the learners' performance to provide personalized coaching. The term "e-learning" refers to a wide range of technologies that facilitate education and training via the internet, such as online courses, online discussion forums, and online seminar rooms. It is possible to utilise AI to programme various aspects of the educational process, including the creation of lesson plans and other pedagogical materials, the delivery of training and instruction, the assessment of student progress, and the adoption of cutting-edge pedagogical practises. As far as cutting-edge e-learning trends go, AI is where it's at in today's academic and business institutions. As a result of AI's use of data analytics,

more informed judgments may be made, leading to improved education and more efficient methods of providing individualised training.

In this paper, we take a historical perspective on the impact that AI has had on the field of Computer Science education and research, as well as a look ahead at potential areas for growth. This paper explains how

artificial intelligence (AI) is included in CS courses. The paper also addresses the incorporation of AI into CS education. In the years since AI research began, the field has expanded significantly. Applying AI methods, refining and expanding upon current methods, and creating brand-new methods are the three primary focuses of study.

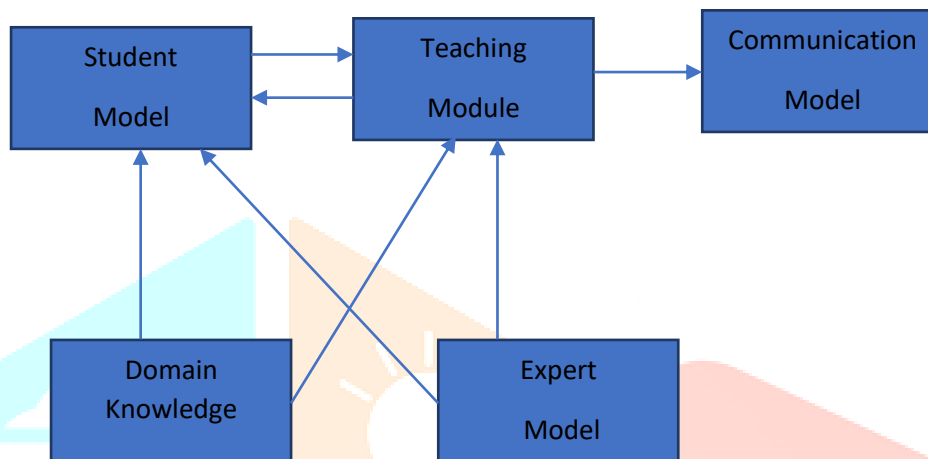


Fig 1: Interactions of Components in an intelligent tutoring system

There is no doubt that artificial intelligence (AI) and its applications in the field of e-learning have been essential in elevating the level of intelligence present in e-learning resources and methods. The goal of incorporating AI into e-learning is to improve students' academic outcomes by making it easier to provide them with high-quality instruction via a digital platform. A more personalised and effective decision-support system for facilities could be made possible thanks to advances in artificial intelligence that could lead to the creation of online learning systems (DSS). The educational system's role may be greatly enhanced if it adopted such a strategy, as it would allow for a greater focus on the individual student and the promotion of his or her academic success. For the better part of two decades, the internet has been used for the distribution of information, the encouragement of active learning, and the provision of remote education.

Student Model:The student data model keeps track of data that is unique to each student. Such a model, at the very least, monitors how well a pupil is doing with the subject matter at hand. Since the student model's primary function is to feed information into the system's instructional component, all data collected should be usable by the instructor.

Teaching Module:This component serves as a template for the educational procedure. The teaching module, for instance, determines when lessons should be reviewed, when new lessons should be presented, and which topics should be presented. Earlier, we saw how the student model feeds into this section, making sure that individual students' requirements are taken into account when making educational choices.

Domain Knowledge:This component is the most crucial because it comprises the material the tutor will be covering with the student. How knowledge should be represented so that it scales well to larger domains is a related research problem. How to represent domain knowledge beyond facts and procedures, such as concepts and mental models, is another open question.

Communications Module:This component manages the screen layouts, including the interactions with the learner input. How can we best present this information to the student? Even though this aspect hasn't been studied as much as the others, there has been some promising study.

Expert Model:Similarly to how domain knowledge must include the material being taught, the expert model must also include the material being taught. To be sure, it's more than just a picture of the data. That

person's mental representation of the domain's knowledge (one that can effectively apply that knowledge to problem-solving) is the mental model. The tutor can see where the student struggled by comparing their solution to the expert's solution (generated by the expert model).

2. LITERATURE REVIEW

Mrs. C. Beulah In 2016, Christian Latha presented a personalised e-learning framework that would allow the learner's individual learning patterns, objects, styles, and pathways to be identified. Association rule mining is used in the FSML implementation to determine a student's preferred mode of instruction. The complexity of the learning object and the students' current level of knowledge are used in conjunction with an apriori algorithm to determine the students' current knowledge. The genetic algorithm technique is used for learning path optimization. Content-based filtering, collaborative filtering, and hybrid approach are used for learning path recommendation. The researcher suggested a need to focus on learning duration as it is an important parameter in measuring e-learning performance.

NilaykumarMohitkumar Vaidya (2017) focuses on a learner-centric approach to elearning. It uses synchronous and asynchronous collaborative learning techniques. According to the researcher, correlation between tutors, learning behavior, learning content and questionnaires is a critical factor in effective learning. The researcher implements the calibration process to match the expected and the actual outcome. It helps to define new learning rules and strategies in the e-learning environment. To forecast the initial skill competency skill of learner gray theory and multi-object programming are used. The fuzzy membership function is used for evaluating the learner's knowledge level. Research needs to focus more on learners' individual parameters for better analysis. Data mining algorithms and appropriate AI techniques are necessary for a personalized collaborative e-learning environment

Nikila Kothari (2017) elaborates on a broad overview of the impact of AI on e-learning techniques. Artificial Intelligent in e-learning provides real-time querying and can be work as an assistant for providing knowledge resources. AI plays a vital role in gamification based e-learning to create learning interest among the learners. AI imitates emotion enough to create a more engaging experience because learning is an emotional process where gaining new knowledge is happiness.

V. Kavitha, ReshamLohani (2018) elaborates on the role of artificial intelligence to enhance the virtual learning environment in e-learning. They suggested implementation of an instructional design model called ADDIE (Analysis, Design, Development, Implementation, and Evaluation) to design courses, content and evaluate learning experience. System design (UI) plays an essential role in motivating and retaining the interest of the learner. Researchers suggested using the Fleming model to integrate different learning tools like Audio learning, visual learning, read/write learning, and kinesthetic learning for an interactive e-learning system. According to researchers, artificial intelligence plays an important role to facilitate the diagnostic process that identifies studentsbehavior, level of learning, module suggestion as per prerequisite, assessment of learning in the continuous interval, finding the difficult area in learning, manipulate various multimedia presentations according to the learning style of a learner and adjust teaching pedagogy as per student requirements. AI helps to identify the cognitive behavior of learners to support the personalized learning experience.

Padmaja Appalla, et al. (2018), proposed a hybrid fuzzy-based mapping and recommendation algorithm to analyze student profiles and learning activities. Collaborative sequential map filtering algorithm implemented for sequential mapping, identify students with similar learning interests and collaborative filtering. The matching algorithm helps find an association between students and their requirements to recommend e-learning material for the individual learners. A cloud-based database is used to store each learner's behavior, learning time and knowledge level, etc. A treestructured fuzzy-based learning activity model was developed according to learners' profiles for an appropriate recommendation of e-contents to the learner. The proposed method is suitable with a variety of learning materials like pdf, audio, video, text, and getting better results through the fuzzy model compared to a knowledge-based recommendation system.

Sankar Pariserum et.al (2019) has described the importance of Fuzzy logic implementation while developing an e-learning system to suggest suitable e-resources that increase students' interest in an e-learning system. Frequent pattern analysis technique of data mining is used to identify learners' recommendation, while Fuzzy logic is used to classify learners into simple, medium, and high levels. Computer science students information regarding frequent users'

suggestions, data access patterns, search topics, and popular e-learning sites prefer are recorded in the database. The researcher used Java and MongoDB technology for developing systems.

3. E-LEARNING TRENDS

In India, due to the digital revolution, the number of internet users is increasing day by day. Internet technology reaches not only the urban area but also the rural landscape too. So there is tremendous demand for e-learning in India. According to the Global Industry Analysis, the e-learning market will reach \$325 billion by 2025. As per the statistical report, various private universities offer e-learning courses to their undergraduate and postgraduate programs. Ministry of electronics and information technology websites motivate e-learning as an essential tool for dynamic education. The government also provides aides for research and development projects in e-learning that focus on content development, faculty training, human resource development, etc. As per the online education report in India-2021, there is growing dependability on the internet for education, leading to huge scope for the e-learning market and corresponding employment opportunities.

Learners' skills and knowledge requirements are continually changing as per new trends in the learning curve that suddenly reflect e-learning practices. It provides peer to peer communication between learner and tutor. Today e-learning plays a vital role in corporate training to provide professional training to employees without human involvement. The organization motivates to develop dedicated custom e-learning software to provide training to employees. It helps the organization to save time and money. The employees who can work from home and e-learning are a better choice to solve their problem through e-learning. E-learning software displays e-content in various formats like a graph, charts, audio-video lectures, discussion forums, etc. Many e-learning applications support customer support platforms like Android, ios devices, and mobile, laptop, tablet. In 2020 big data and AI technology significantly contribute to learner analytics to monitor learners' activities and comply with their efficiency. To enhance the effectiveness of the e-learning system, machine learning algorithms can be incorporated into the processes of collecting, analysing, and keeping tabs on learner performance data. E-learning technologies are categorized into synchronous and asynchronous

learning trends. Synchronous e-learning is real-time learning that includes virtual classrooms, webinars, video conferencing, instant messaging, chat, and online discussions. Asynchronous e-learning includes delivery of e-learning material via web, email, message boards, video lectures, online PowerPoint presentation, discussion forums etc.

Artificial Intelligence has the immense power to revolutionize e-learning and saves learners time and expenses. This would not burden learners because the AI-based e-learning platform will automatically provide all education-related information. Elearning motivates the learner to acquire the knowledge, enhance the skills for better decision-making, and solve real-time problems.

Following are some famous e-learning technologies:

Blended learning: It is a modern technique of providing education to students using electronic media, e-material, and online resources for student-teacher interaction with traditional classroom methods. It's a hybrid method of education that uses both digital and analogue resources.

Collaborative learning: It is an e-learning approach where students socially interact with other students and teachers. Students can enrich their knowledge and learning experience by interacting with other students. It is an interactive learning process that motivates learners to acquire and exchange knowledge, skills through instant messaging, forums, chats, message boards, etc., among a collaborative team of learners.

Google Classroom: It is a free web-based service provided by Google to create and share e-study material between student and teacher and grading assignments, conduct online tests, and generate performance reports of students. It is a teacher-centric online education technique for communication between students and teachers.

MOOCS: It is a social learning platform called Massive Open Online Courses for learners to learn from the web. It provides open access to e-content, a structure that promotes the reuse of existing resources. The leading massive open online course (MOOC) providers are Swayam, NPTEL, Coursera, edX, Udacity, Udemy, FutureLearn, NovoED, Iversity, Canvas, Open2Study, Open learning, and Open learning.

Gamification: It is an informal e-learning technique to engage the learners. This method system can provide rewards, success badges or levels, and virtual currency to motivate learners". Learning performance can be analyzed from the learners" engagement and achievements. If one crafts the gamification technique in teaching, it will help to capture and retain learners" attention, skill, and challenges and motivate them to complete a learning journey with fun. Based on a survey done by the elearning industry, 80% of learners said that gamification is a better way to keep learners interested and motivated.

4. METHODOLOGY FOR AI BASED LEARNING ANALYSIS

Learning behavior analysis is a fundamental challenge in today's education system. It depends on a lot of factors, like the learner's skills, interests, perceptions, attitudes, abilities, and feelings. It is a part of the learning environment that changes over time. Analysis of how people learn helps teachers choose the best way to teach them based on their needs and interests. To make a personalised e-learning system, it's important to know how learners learn so that the best learning experience can be made. Through this research, a fuzzy system for analysing how learners behave is made. An artificial neural network is used to figure out how well the system works.

4.1. Introduction

Artificial intelligence means machines or computer systems that are made to be smart and can learn from what they do. It is a way to solve hard problems by learning from experience. With AI implementation, we can make a machine that can roughly think, act, and work like a person. It is a simulation that involves learning, thinking, and making smart choices. Software that is based on AI is being made that can simulate, perceive, learn, make decisions, reason, and represent knowledge.

Researchers in the past have come up with a way for personalised e-learning systems to help students do better. The main focus of the study was to look at how students learn in the classroom and how teachers teach. Intelligent e-learning systems, on the other hand, are made without taking into account how people learn, which is an important part of any e-learning system. For personalising education, techniques that are based on expert systems are used. Machine learning techniques and algorithms are used to figure out how smart a learner is, but no interactive system has been made to teach learners based on what they already know and what they're interested in. According to the review of the literature, an AI system can change to meet the learning needs of an individual. It can help the students learn in a way that is meaningful to them.

Learning style differs from learner to learner. Learning style means the preferred way of absorbing, understanding, processing, and retaining the information to learn something with satisfaction. An Individual's learning style depends on various factors like learner's interests, emotions, psychology, cognitive ability, experience, and environmental conditions. A tutor needs to understand individual learners' learning styles to implement best teaching practices while designing the curriculum, providing training, and assessing

4.2. Fuzzified Rule Based System for Learners Behavior

Analysis Learning behavior varies from learner to learner. It is a dynamic factor in learning and challenging to predict the exact behavior of the learner. In order to isolate the learner's behaviour in the classroom, a fuzzified rule-based system is developed. Fig.2 shows a proposed model of a Fuzzified Rule-Based System for learner behavior analysis.

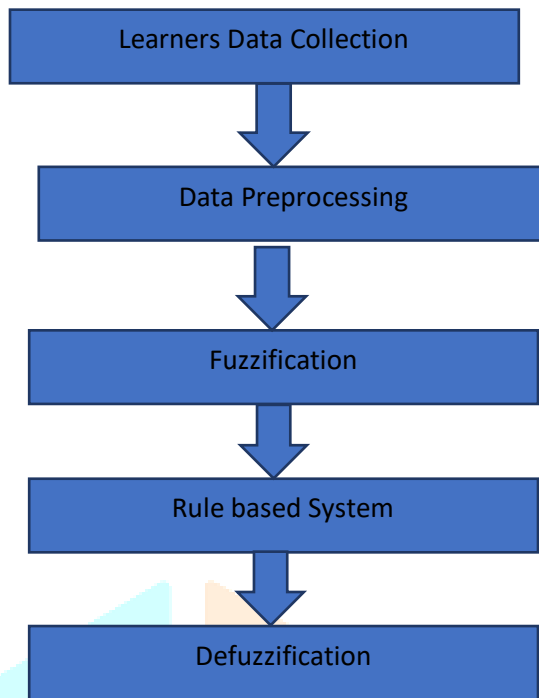


Fig 2. Proposed Fuzzified Rule Based System

There are two distinct types of learners: those who absorb information slowly and those who absorb it quickly. By analysing students' reading comprehension, listening skills, aptitude, memorization, extracurricular activities, study habits, and other relevant factors, we can determine their learning behaviours.

4.2.1. Data collection: Moodle is used to gather information about students. The sample for this study consists of 320 advanced-level undergraduate (UG) students majoring in Computer Science/Application. Using these components, a database of learners can be built.

1. Personal Information: Students' names, ages, genders, X and XII grade point averages, percentages earned in the first and second years of school, the number of students with outstanding assignments, the percentage of students who regularly attend class, the amount of time spent studying each week, and other relevant data are collected via an online questionnaire.

a. E-Reading: Course readings are made available to students through an online platform. A multiple-choice question (MCQ) test is offered to identify the learner's recalling capability through reading.

b. E-Listening: The student can see and listen to the lectures using the online platform. To gauge the

student's capacity for remembering what they heard, an MCQ test is made available.

c. Aptitude: An online test is provided to determine the logical capability of the learner through aptitude.

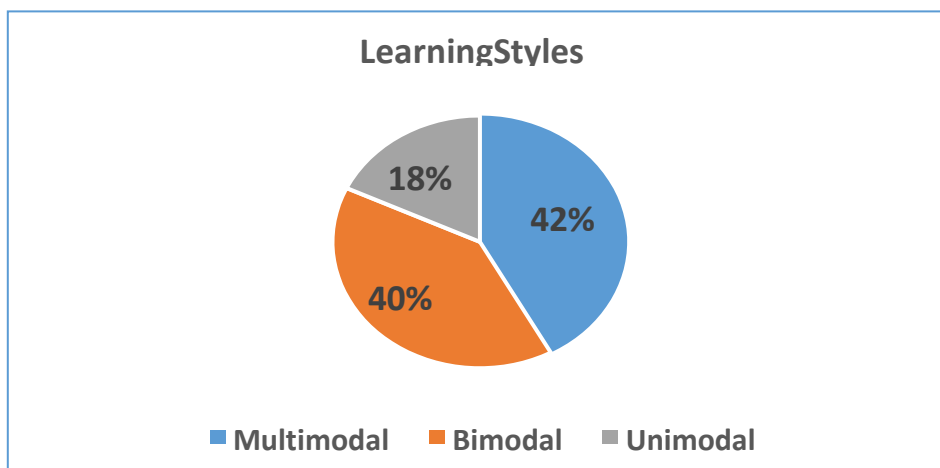
4.2 Data Preprocessing:

Learners Data is extracted from ".csv" file. This file is a collection of learner's information like PRNNO, Personal Information, and Time taken by the learner to attempt reading, listening, and aptitude test and the score of each test, respectively. MsExcel macros are used for data cleaning, preprocessing and normalization. Each test performance is measured from test score, and the learner takes total time for attempting the aptitude tests.

5. EXPERIMENT AND RESULT:

Data regarding Learning preferences of 1240 learners are collected through the Moodle webportal using the above questionnaires. It consists of 16 questions to identify the learning preferences of the learner.

Dataset is generated with a score for each learning style Auditory, Reading, Visual and Kinesthetic learning style of the individual learner. It is observed that, more than 70% of



learners having multimodal and bimodal learning styles. Following Fig 5.1 shows the pie chart that depicts the average percentage of learners in Unimodal, Bimodal and Multimodal learning styles.

Fig.5.1: Different Learning Styles

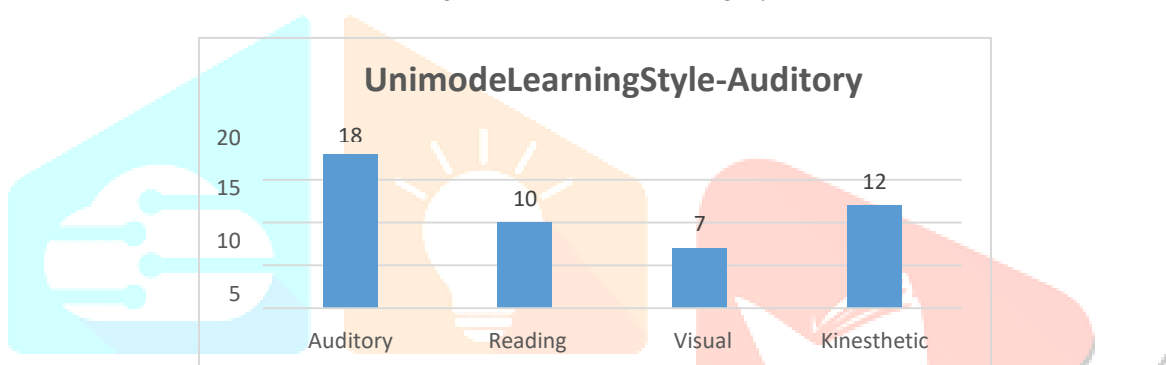


Fig 5.2: Unimodal Learning Style

Fig 5.2 shows sample score of learner having Unimodal learning style. Here learner prefers Auditory learning style with maximum score 18.

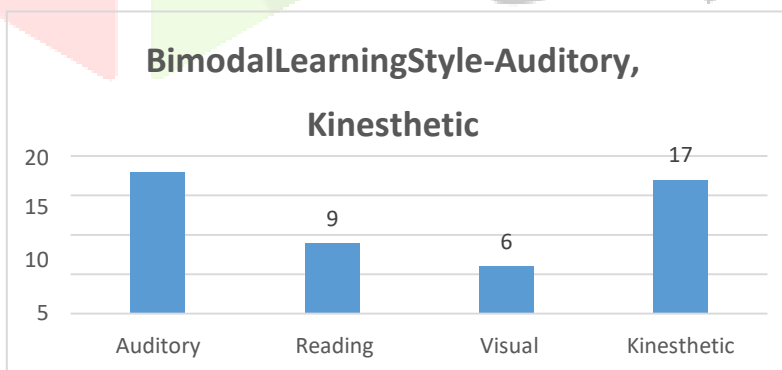


Fig 5.3: Bimodal Learning Style

Fig.5.3 shows sample score learner having Bimodal learning style. Here learner prefers Auditory and Kinesthetic learning style with score 18 and 17 respectively.

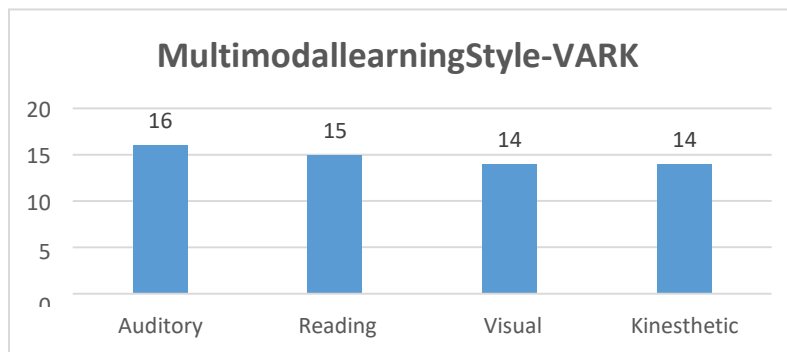


Fig5.4:MultimodalLearningStyle

Fig.5.4 shows sample score of learner having Multimodal learning style. Here learner prefer all four learning styles with score 16, 15, 14 and 14 for Auditory, Reading, Visual and Kinesthetic respectively.

5.1.1 Learning Styles:

According to educationalists using multimodal learning styles, it is difficult for the tutor to provide training by applying all teaching strategies simultaneously. It will create confusion among learners as well as a tutor. Unimodal learners must use only one methodology like either practical exercise, video, or assignment. So sometimes, in the learning scenario, it is not suitable to provide e-material in a specific/ single format. Bimodal learning style is the better method to provide content according to learner's preference. It helps to avoid confusion, and the learner can enjoy an alternative way of learning for better satisfaction. Here dataset of 1240 students is used to decide the bimodal learning styles of the individual learner.

5.1.2 Data Preprocessing, Visualization and Computation:

Excel macros are used to create a training dataset. [Refer: ANNEXURE-I: 2.1 for Ms-Excel

Macro Code] Dataset with 1000 learner's records considered for training dataset. Whereas 240 learners' records are used for the testing dataset and a

dataset of 100 learners is used for validation testing. Two most preferred learning styles are considered as a bimodal learning style.

Learners Dataset:1240 Records

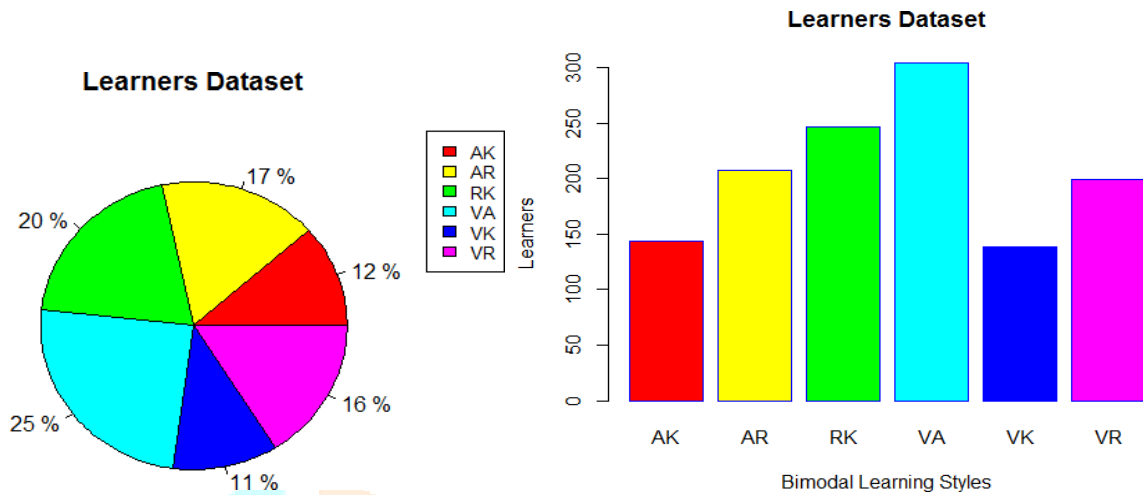


Fig.5.5.BimodalLearningStyles-LearnersDataset

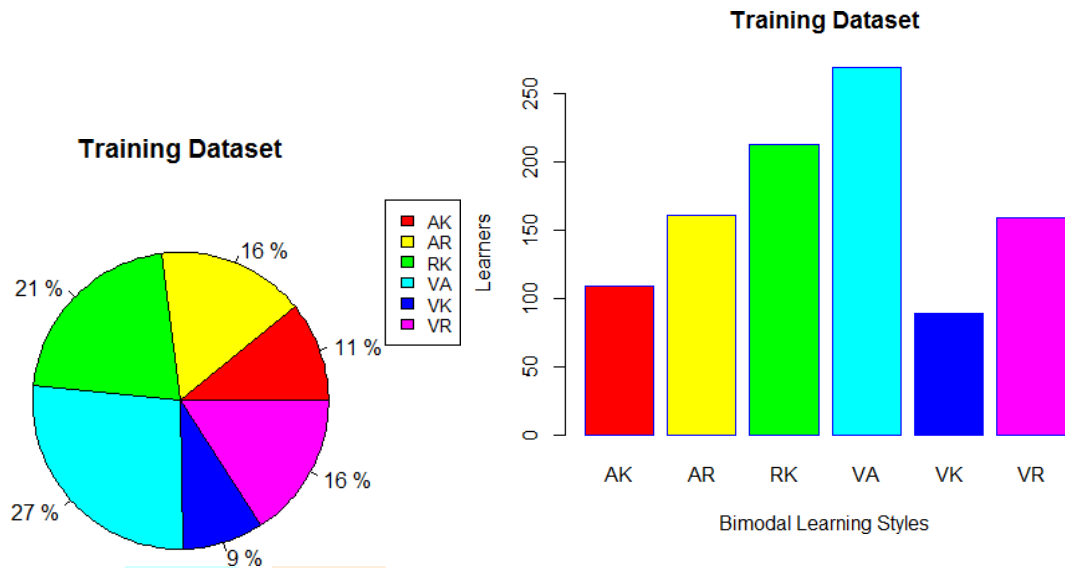
BimodalLearningStyles	AK	AR	RK	VA	VK	VR
Learners	144	207	247	304	139	199

Table5.1BimodalLearningstyles-LearnersDataset

Above Fig. No. 5.5 Pie Chart shows the percentage of each bimodal learning style. 25% learner having learning style VA (Visual Auditory), 20% learner having learning style RK (Reading Kinesthetic), 17% learners having learning style AR (Auditory Reading), 16% learners having learning style VR (Visual Reading). 12% learner having learning style AK (Auditory Kinesthetic) whereas 11% of learners having learning style VK (Visual Kinesthetic). Fig. No 4.7 Bar chart depicts that in an overall dataset of 1240 learners, the learner's most preferred bimodal

learning style is (Visual Auditory) VA whereas the less prefers bimodal learning style is (Visual Kinesthetic) VK.

Table 5.1. Shows a total number of learners for each bimodal learning i.e 144 learners having learning style AK, 207 learners having learning style AR, 247 learners having learning style RK, 304 learners having learning style VA, 139 learners having learning style VK and 199 learners having learning style VR respectively.



TrainingDataset:1000Records

Fig.5.6.BimodalLearningStyles-TrainingDatasetof1000learners

BimodalLearningStyles	AK	AR	RK	VA	VK	VR
Learners	109	161	213	269	89	159

Table5.2.BimodalLearningstyles-TrainingDataset

Above Fig.No.5.6 Pie Charts shows the percentage of each bimodal learning style. 27% learners are having learning style VA (Visual Auditory), 21% learner having learning style RK (Reading Kinesthetic), 16% learners having learning style AR (Auditory Reading) and VR (Visual Reading). 11% learners having learning style AK (Auditory Kinesthetic) whereas 9% of learners having learning style VK (Visual Kinesthetic).

Above fig.5.6 Bar chart depicts that in a training

dataset of 1000 learners; the learner's most preferred bimodal learning style is VA whereas the less preferred bimodal learning style is VK. Table 4.3. Shows a total number of learners for each bimodal learning style i.e., 109 learners having learning style AK, 161 learners having learning style AR, 213 learners having learning style RK, 269 learners having learning style VA, 89 learners having learning style VK and 159 learners having learning style VR respectively.

Testing Dataset: 240 Records

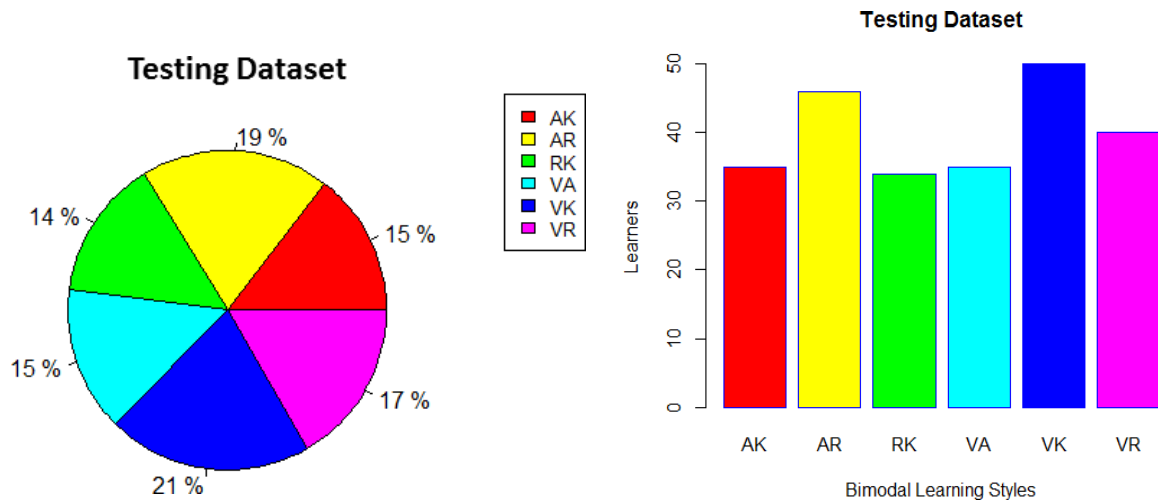


Fig.5.7.BimodalLearningStyles-TestingDatasetof240learners

BimodalLearningStyles	AK	AR	RK	VA	VK	VR
Learners	35	46	34	35	50	40

Table5.3.BimodalLearningstyles-TestingDataset

Above Fig.No.5.7 Pie Charts shows the percentage of each bimodal learning style. 21% learner having learning style VK (Visual, Kinesthetic), 19% learner having learning style AR (Auditory,Reading), 17% of learners having learning style VR (Visual, Reading). 15% learner having learning style AK (Auditory Kinesthetic) and VA (Visual, Auditory) whereas 14% of learners having learning style RK(Reading, Kinesthetic)

CONCLUSION

Artificial Intelligence-based personalized e-learning will help learners learn according to their ability, skill, aptitude, interest, etc. The system provides an optimized learning path for the learner as per their learning behavior and domain knowledge level. E-learning material is recommended to individual learners as per their learning style, which helps to motivate learners to use interactive e-learning systems. This system will be beneficial for assigning remedial coaching to the students through e-learning, where an individual student will get appropriate e-material as per his/her learning style. The system helps slow learners to learn in a systematic approach to learn from basic concepts to advance. In contrast, fast learners who have sufficient domain knowledge can directly start learning from intermediate or advance levels, saving learners time and enjoying better learning experience. Successful implementation of a personalized e-learning system helps to fulfill program outcomes and course outcomes. This

Scientific approach for a personalized e-learning system supports institutes to improve students' learning interest and knowledge level.

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