



Analysis of Fusion of Machine Learning Tools in Education

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Abstract

In this modern world, artificial intelligence has revolutionized human life in multiple ways. Like other fields, education industry is also transforming with the influence of AI with its smart learning platform and automation of tasks. The introduction of fusion of machine learning tools (FMLT) in the field of education helps to predict learning outcomes and identify challenges in learning. The objective of this paper is to study the fusion of application of machine learning tools in education. This paper highlights the role of data driven FMLT in teaching and learning and also analyzes students and teachers' experiences as well as challenges faced during the implementation of FMLT system. This article discusses various machine learning tools that can be fused into academics. The experiment is conducted on students at graduate level and the results reveal an increase of 88% in terms of learning efficiency for the proposed FMLT system compared to traditional methods, which reflects high positive impact of the contributions of FMLT in academics. Results of the findings also reveal that FMLT applications facilitate thinking, creativity, class engagement and quality teaching inside and outside classrooms. The feedback findings express mixed attitudes concerning the use of machine learning tools in classrooms.

Keywords: Fusion machine learning; Artificial intelligence; Education; Teaching and learning.

1. Introduction

Education system provides development standard for individuals and hence researchers conduct studies exploring fusion of artificial intelligence (AI) technologies with educational system. Machine learning tools (MLT) has gained immense popularity in the development of artificial intelligence in scientific computing. Machine learning is a sub division of artificial intelligence which focuses on data and algorithms. It helps machine learn on its own and make decisions like humans, with the help of artificial neurons. Artificial neurons can work without being programmed and can perform tasks such as image recognition, speech recognition, medical diagnosis, predictive analysis and extraction.

Fusion learning provides an overall integration of AI tools in teaching and learning. To unleash the contributions of fusion learning, education institutions are gradually implementing machine learning AI tools to facilitate teaching and learning and overall growth of student performance.

Fusion of machine learning tools (FMLT) in education field has transformed the approach towards learning, teaching and even research studies. With the rapid growth of artificial intelligence, AI tools are gaining popularity in all fields of life. AI tools optimize network operations and provide humans freedom to make decisions in business, administration, academics etc. It has revolutionized human thinking, health, education, fraud detection, malware threat, customer division, forecasting demand, personal assistance and many other. Machine learning models such as support vector machine and decision trees aid in predicting students at risk and in understanding learning patterns of students. Educators can use machine learning models for class management, gauge student performance, prepare course plans and automate grading.

In this paper, we have incorporated FMLT framework with the objective to find the impact of FMLT on students.

In this paper, section II is literature review, section III discuss machine learning in education, section IV describes research methods, section V shows results of the research and section VI concludes the paper.

2. Literature Review

The huge digital transformation in 21st century has helped the education field. It has helped students enhance learning through the use of digital tools [1]. There are several ways to implement FMLT into teaching. Students have different level of intelligence and machine learning techniques can support their learning habits to suit their needs [17]. Machine learning has ability to learn from past using data algorithms and make decisions and predictions [19].

Development in sensor technology and its ability to collect big data and deep learning has contributed towards analytic solutions [20]. The rapid growth of digitalization technology and the need for machine learning contributes tremendously to ever growing global data set [21]. Artificial intelligence (AI) technology which gives devices the ability to learn and predict outcomes without human intervention [22]. In learning, fusion of virtual reality (VR) provide interactive experiences to help students enhance language or practical skills. VR based teaching materials support student interaction by taking them to virtual worlds [2]. VR approaches can detect user movement and actions. AI Chabot's have significant effect in academics and provides conversational support and guidance to students to improve their learning experience [3]. Real time machine learning translational software can identify text to speech or image to text and has improved teaching outcomes. The origin of machine translation can be traced back to early 9th century cryptographer [4]. It refers to a process of automatic text to text conversion from one language to another without human interaction [5,6]. Popular machine translation approaches are rule-based machine translation (RBMT), statistical machine translation (SMT), and neural machine translation (NMT). The introduction of neural translation approach drastically enhanced the translation accuracy. Software such as google translate software's has been a cutting edge [7] in the world of communication.

Machine learning has contributed incredible openings in various fields such as, artificial intelligence, neuroscience, medical science and education field. Machine learning in medical field has helped professionals to manage medical data, patients, image identification and in developing diagnostic devices [8]. In educational institutions it is common for students to use translational tools [9]. Neural machine translational tools help students in language learning [10]. Machine learning technology can analyse sentences in second language learning, translations and interpretations [11]. Students can face problems to integrate machine learning tools in education [12]. Students should acquire training to use machine learning tools when they use it for academic learning [13].

Bowker [13] mentions six important points in acquiring knowledge in machine translation, emphasizing i) privacy, ii) intellectual integrity, iii) algorithmic bias, iv) literacy in using different tools, v) knowledge of types of translational tools, and vi) providing better input to acquire better output.

Machine learning creativity tools play an important role to improve and engage students' reading practices [14]. Zhen et al. [15] examined 40 articles related to machine learning tools. Students' attitude towards ease of learning educational tools play a crucial role towards the implementation of machine learning tools. Attitude of teachers to explore and integrate digital advancements into teaching could influence the mind set of students and learning [16]. Studies reveal that institutional support to train educators towards using technology will have positive impact towards technology adoption in teaching and learning both theory and practical, in various fields of education [17]. Training educators to use technological tools provide greater benefits and facilitate higher level of learning as educators play a vital role in motivating students to acquire self-directed learning [18].

3. Machine Learning Tools in Education

Fusion of artificial intelligence(AI) has been a boom in the field of education. It develops personalized learning skills for learners. AI powered classrooms are educational platforms that integrates AI into teaching to enhance teaching learning experiences. Adaptive content making, instant feedback, active engagement, automated grading and reflection are the main features of AI powered classrooms.

Applications like Google translate which is heavily used by students with language problem, provide automatic and quick translational methods, implementing deep learning techniques to accurately predict words syntactically [23]. The advancements of these learning models are so high that it can discover and filter even spams or phishing with 99.9% accuracy [24]. A sample model of deep learning algorithm is shown in Algorithm 1:

Algorithm 1:

Step 1: Input: training examples with learning rate, iteration etc.
 Step 2: Output: for each training example
 Step 3: Perform feedforward computation
 Step 4: for other layers and LBE layer
 Step 5: Compute the gradients
 Step 6: Update weights and bias
 Step 7: Return result

Institutional data security is a critical area to be taken care off. FMLT acts as an efficient assessment system as it can collect responses, evaluate and provide feedback. In such assessments, questions are stated and written response is given by test takers. For each question, learning models are built to predict unseen responses from different test makers [25].

Machine learning tools (MLT's) can solve problems related to wide range of applications where computer learns without being programmed from the data or input and can improve their performance over time. In the field of education, machine learning programs can process natural language or deep learning. Predictive analysis permits to adjust the levels of course according to individual needs. Educators identify procedures to integrate machine learning tools (MLT) into the curriculum. Teachers can introduce and educate students to use MLT's at moderate levels. Students are allowed to use tools to complete tasks or assignments collaboratively or individually. Tasks assigned can be in the form of writing, exploring, solving practical work, solving equations etc. Students are assessed by the teachers and feedback is provided as part of reflection using ML tools. ML tools are also used to enhance creativity and aid in co-curricular activities such as role play, creative thinking etc.

Adaptive learning is one the best features of machine learning which is used in education sector. Algorithms can learn student behaviour of students by monitoring their activities e.g. amount of time spent for attempting tasks and generate results based on their performance in assignments or quizzes. This learning can be used to tailor courses or assessment pattern as per students' potential. Some of the adaptive machine learning programs that can be used as part of academics are:

- iTalk2Learn system: math learning platform to learn fractions
- DreamBox: online math solutions and provides reading solutions
- MyLab: provides personalized learning platform
- Kidaptive and Knewton: adaptive learning technologies
- New Classrooms/Thinkster Math: math learning platforms that can track students' progress gap and offer appropriate learning materials. Real-time results and suggestions can be generated
- Khan Academy: an interactive educational program with a range of academic subjects

Fusion of different machine algorithms can be used in teaching for giving feedback in synchronous learning system. Machine learning course recommendation applications extract knowledge from learning management systems (LMS) like Moodle and can be integrated with online courses such as MOOC to promote learners experience. Moodle platform maintains complete log of all the participants registered to a course and keeps track of the student activities, generates reports, make announcements, create quizzes/assessment/assignments, generates grades, provides feedback and can predict outstanding, pass or failure (risk) rate [26]. Moodle is widely accepted FMLT system that provides practical teaching experience for higher education [27] and stimulates self-learning with the help of lesson handouts, audio/video lessons, forums, activities (h5p) quizzes, assessments uploaded in the platform. FMLT's are predictive analytic systems that has potential to explore, analyse and predict results based from the educational data [28].

Figure 1 is an example of a flowchart of a simple use of course selection system.

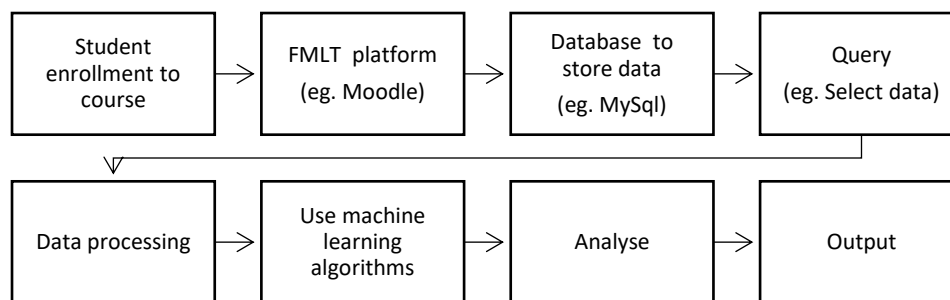


Figure 1: Sample course selection system.

4. Methodology

In this paper, we have incorporated FMLT framework in classroom teaching with the objective to find the impact of FMLT on students. This paper, analyses the experiences of both students and teachers using FMLT in classroom by collecting their feedbacks. Figure 2 shows proposed methodology.

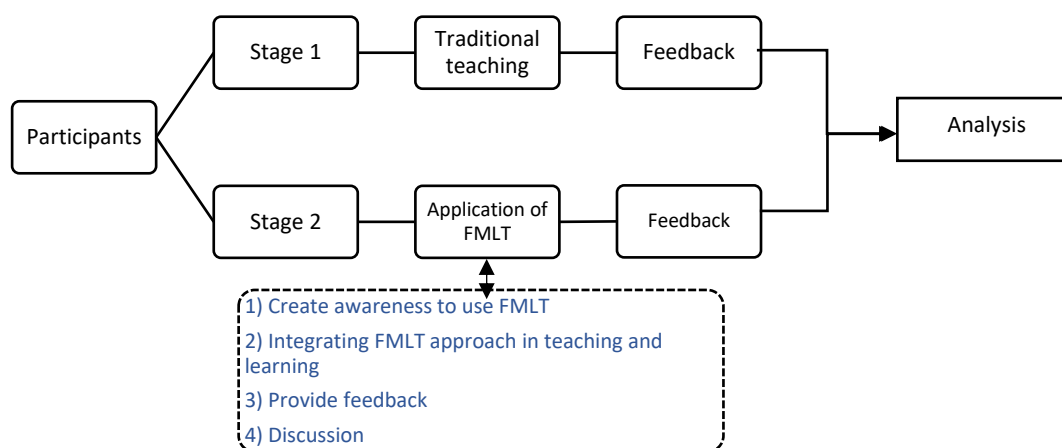


Figure 2: Proposed methodology.

A. Participants

In this research, participants are graduate students consisting of boys and girls (20 participants) from two majors and their respective teachers in a private university. The experiment was conducted in two stages.

Stage 1: Participants are first taught using traditional method

Stage 2: Participants switch to FMLT approach

Same set of participants undergo stage 1 and stage 2 of the experiment. This way comparison is easier.

a. Stage 1: Traditional Teaching (TT)

Features:

- needs teacher presence (TT possible only inside classroom not outside)
- listen to lecture
- take down notes while listening lecture (at this point they may miss some key aspects even if they have good writing speed)
- understand concept (benefits students with good language skill may follow the concept well in contrast to multimedia lessons which can be paused, rewind and heard n number of times)
- rote memorization
- ask questions (only one at a time)
- peer learning

- in-class activities (teachers spend more time here to evaluate student performance)
- full-time teacher engagement (correction of assignment/assessments marked manually)

b. Stage 2: Application of FMLT

Using FMLT is relatively a modern trend applied in teaching by educational institutions. It is a fusion of technology, hardware and software such as, sensors, graphics, artificial intelligence etc. implemented for educational purpose

Features:

- smart learning platform
- creates a simulation 3-D dynamic interface to interact with the user
- supports multimodal input (type, sound, touch etc.)
- demands can be differentiated (this is possible due to deep learning algorithm used to create activities and tracking)
- application of virtual reality based interactive classroom (can be accessed both inside or outside classroom)
- 3-D learning space is close to real world experience
- interactive class
- self-learning
- relaxes teacher when students are monitoring multimedia lessons
- assignments can be done and monitored inside or outside the classroom
- can analyse data collections of learners, learn patterns and create new learning models
- can make suggestions or recommendations
- generate grades automatically (frees teacher from monotonous correction work)
- novel assessment method
- predict results

B. Research tools

The tools used are:

- Questionnaires: for students was prepared. Students were advised to scan the QR codes using their mobile phones and complete the questionnaire questions. A 5-point Likert scale was used to record respondent's level of agreement with the questionnaire statement. Each answer to a question was given a score. A 5, 4, 3, 2, and 1-point score was given to a response strongly agree, agree, disagree, strongly disagree and neutral respectively. Cronbach's alpha test was used to measure the consistency of the Likert questions. Questionnaire statements was explained to students prior to their feedback.
- Interviews: for both students and teachers separately to identify their attitudes/experiences pertaining to the integration of learning tools in teaching and learning. Interview response was transcribed for analysis using SPSS statistics 22.

C. Data collection

As part of experiments stage 2, teachers were i) trained to use MLT's prior to the session and ii) advised to practice the following iteration given in figure 3, in their class to produce effective results. As teaching platform, participants of this research incorporated AI tools, such as:

- Video management system to prepare video lessons.
- Personalized learning experience using AI powered educational platform and translation program.
- Gamification.
- AI to recommend course that match students level of understanding and adjust difficulty levels of questions.
- AI powered technology to monitor students.
- Document verification.
- Assess students' strengths and weaknesses.
- Provide immediate real time feedback.

Students were advised to use computers/laptops/tab/mobile phones at moderate level in their classrooms.

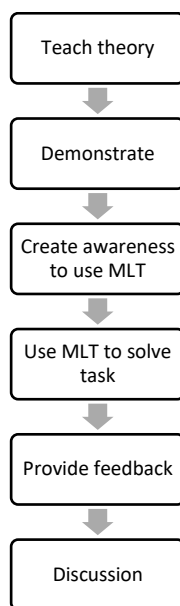


Figure 3: Flowchart of FMLT implementation

5. Results

Experiments are conducted to confirm the effectiveness of the study. To confirm the validity of this study on FTML’s teaching and learning strategies efficiency, a questionnaire with 6 statements was designed to check the experiments validity. Same set of questionnaires were distributed in two stages. The findings of the two stages were compared and analysed. Traditional teaching approach is compared with the proposed method, FMLT, to find the teaching and learning strategies efficiency of this work. Learning efficiency depicts the relationship between experiment score and perceived mental effort (PME) of the learner. It shows the time taken by learner to complete a task/experiment correctly.

A. Survey Report

Table 1 depicts comparison of achievement improvement rate for TT and proposed FMLT approaches rated by students.

Table 1: Survey result.

S. No.	Question	TT	FMLT	Improvement Graph
1	Learning interest	↓ 2.5	↑ 4.5	
2	Motivation to learn	↓ 2.9	↑ 4.5	
3	Pro-active	↓ 2.2	↑ 4.6	
4	Self confidence	↓ 2.5	↑ 4	
5	My assignments are better	↓ 2.4	↑ 4.5	
6	Independent learning	↓ 2.6	↑ 4.3	
Average mean (out of 5):		2.5	4.4	

The questionnaire results report the crucial role played by FMLT in different aspects of the pedagogical use. Results show that when compared to TT method, the proposed FMLT method has greater learning efficiency. TT has 50%, and the proposed FMLT has 88% learning efficiency.

A high mean score of 4.6 for pro-active, shows FMLT is successful at keeping the class engaged, 4.5 mean score for learning interest, motivation to learn and my assignments are better, shows FMLT successful at helping students to manage their assignments without peer help and thus motivating them. It has taken out the fear of doing assignments from students’ mind. A mean score of 4.3 for independent learning, shows students’ confidence to learn at their own pace at any time. Self-confidence (mean=4) is little less compared to other scores because of the

hesitance to use new technology. However, average mean shows 74.8% increase, which shows greatest satisfaction of students for FMLT. Figure 4 displays the outcomes of the experiment graphically.

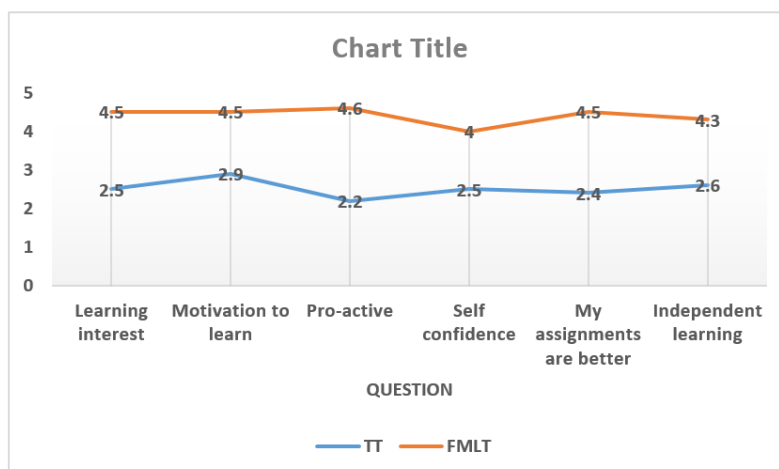


Figure 4: Learning outcomes.

B. Students' interview feedback

Positive points recorded after the interview on using machine learning tools are:

- communication with teachers or peers easier
- helps in language learning
- enhances pronunciation, grammar and spelling
- best writing assistant and improves creativity and writing quality
- videos lessons, games and recommendation of course that match the level of understanding is very helpful
- assignments are better when using FMLT

Challenges: However, students raised concerns regarding the use of MLT's, such as:

- ML tools output are sometimes unreliable and inaccurate in terms of sentence formation, writing style, phrases, concept and content
- suppresses human critical thinking as students' become over dependent on using ML tools
- technical issues
- hesitance to use technology

C. Teachers' interview feedback

The positive attitude experienced by teachers are:

- introducing ML technology in classrooms boost teaching experience as it brings newness in teaching
- translation software's help better communication as it helps native speakers understand and participate in the discussions
- assessments are easier
- assignment grading is easier

The highest mean 3.9 is recorded for assignment, quizzes and assessments are graded better and faster when using MLT, which shows that MLT has benefited and contributed to free teachers from the monotonous task of assignment correction and providing feedbacks. The lowest mean (3.2) is recorded for I am aware of using MLT technology. This can be improved by giving proper training sessions to teachers and using MLT's more frequently in the classrooms.

Challenges: The major concerns reported are:

- technology acting as hindrance to the overall development of students' potential and skill, due to over dependence
- lack of confidence to use technology
- organizational support
- time consuming and affects portion coverage
- feedback provided is not always reliable as it depends on the knowledge of using technology

However, the concern raised by both teachers and students regarding FMLT were:

- overuse and dependence of technology, and
- technology acting as hindrance to the overall development of students' natural potential, skill and pedagogical growth.

6. Conclusion and Analysis

Advancement in technology has its high impact in reforming educational pedagogical practices. Fusion of machine learning tools technology is one of the new trend used popularly in the field of education. This implies that applying FMLT has its benefits to students. There are challenges at the same time and we have addressed them in this paper.

In this experiment, the targeted participants are graduate students and their respective teachers from a private university. Participant teachers have integrated FMLT in their classrooms as per the teaching norms. The research question focused to know students and teachers' attitude towards using FMLT in the classrooms.

Questionnaires and interviews were used for analysis. The findings reveal mixed attitudes by teachers and students. With proper training the fear to use technology can be overcome.

ML technology should be integrated with the curriculum so that teachers and students gradually get familiarized and comfortable to use. Following guidelines was followed in this research:

1. Present the topic for teaching.
2. Identify to use appropriate tools for teaching the topic.
3. Demonstrate the lesson to students.
4. Introduce ML tools to students.
5. Assign task to students.
6. After finishing task, allow students to correct or add creativity with the help of ML tools.
7. Provide feedback using ML tool.
8. Compare the results between self-work and ML tool assisted work.
9. Involve in discussions using ML tools.

ML tools used by teachers:

- AI assisted planning and grading which otherwise is monotonous and time consuming.
- Speech recognition software (used to dictate task, assess task etc.).
- Live chat.
- Virtual learning assistants/apps that mimics human tutors with step by step tutoring that helps personalized learning, student engagement and improve critical thinking skills.
- Gamification.
- Prepare personalized learning plans for students using AI platform.
- Track progress, knowledge gaps and provide recommendations in learning.
- Using adaptive learning technology for multiple course to promote personalized learning.

ML tools used by students are:

- Speech recognition software (used especially by those who have writing difficulty).
- Virtual learning assistant software that provides one-to-one real-time adaptive learning and provides customized feedback.
- Audio visual vocabulary applications for language learning.

Students expressed positive attitude as it provided language learning, translation, virtual learning assistance, communication, feedback and track progress. Although it reduced academic pressure and helped them to score better grades, they expressed their disregard in terms of unreliable output, confusion, tech. adoption and favoured human thinking and classroom face to face learning.

Teachers expressed positive attitude as it provided teaching assistants, assessment tools, grading system, track progress and provide feedback. It helped in reduced dropout rate. However, they expressed their disregard in terms

of overdependence in using AI tools which handicaps students natural thinking process and they felt dissatisfied with the grades scored by students since it is mostly due to tech. integration. They felt that sometimes an average student with good tech. background scored higher compared to an above average student with less use of tech. Hence a balance has to maintained at using AI related tools and its applications in classrooms.

In this study, the contributions of machine learning tools are found in following. In spite of the significance of fusion of FMLT in academics, few drawbacks of the excessive use of FMLT approach was also observed. areas:

- Adaptive learning.
- Predict future performances of students' in class based on their class activities which helped in reduced dropout rate.
- Using AI powered tutor programs.
- Using Chabot's and real time translation applications.
- Automation of monotonous tasks and recommendation/reflection/ feedback engines.
- Using virtual reality.
- Using customized training platforms for learning.

Machine learning tools play a crucial role in interactive learning. It promotes team-based learning and stimulates problem solving skills. Using machine learning tools in classrooms enables short cycle time between teaching, practicing and providing instant feedback. This supplements students thinking, participation and active learning.

The survey analysis concludes that:

- Students as well as teachers hold positive attitude towards using machine learning tools in classrooms. However, few challenges persisted regarding the technology and its adoption.
- Teachers attracted more interest in using machine learning tools than students. However, students enjoyed classrooms which embedded machine learning tool platforms.

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References

- [1] perspective for understanding digital transformation in higher education: Overview and subregional context in Latin America as evidence. *Sustainability* 2021, 13, 12956.
- [2] Huang, X.Y.; Zou, D.; Cheng, G.; Xie, H.R. A systematic review of AR and VR enhanced language learning. *Sustainability* 2021, 13, 4639.
- [3] Yang, H.; Kim, H.; Lee, J.H.; Shin, D. Implementation of an AI chatbot as an English conversation partner in EFL speaking classes. *ReCALL* 2022, 1–17.
- [4] Cancedda, N.; Dymetman, M.; Foster, G.; Goutte, C. A statistical machine learning primer. In *Learning Machine Translation*; Goutte, C., Cancedda, N., Dymetman, M., Eds.; MIT Press: Cambridge, MA, USA, 2009; pp. 1–38.
- [5] Alhaisoni, E.; Alhaysony, M. An investigation of Saudi EFL university students' attitudes towards the use of Google Translate. *Int. J. Eng. Lang. Educ.* 2017, 5, 72–82.
- [6] Omar, A.; Gomaa, Y.A. The machine translation of literature: Implications for translation pedagogy. *Int. J. Emerg. Technol. Learn.* 2020, 15, 228–235.
- [7] Xu, J. Machine translation for editing compositions in a Chinese language class: Task design and student beliefs. *J. Technol. Chin. Lang. Teach.* 2020, 11, 1–18. Available online: <http://www.tclt.us/journal/2020v11n1/xu.pdf>.
- [8] Anazawa, R.; Ishikawa, H.; Takahiro, K. Evaluation of online machine translation by nursing users. *Comput. Inform. Nurs.* 2013, 31, 382–387.
- [9] Archila, P.A.; de Mejia, A.-M. Bilingual teaching practices in university science courses: How do biology and microbiology students perceive them? *J. Lang. Identity Educ.* 2020, 19, 163–178.
- [10] Lee, S.M. The impact of using machine translation on EFL students' writing. *Comput. Assist. Lang. Learn.* 2020, 33, 157–175.
- [11] Han, C.; Lu, X. Can automated machine translation evaluation metrics be used to assess students' interpretation in the language learning classroom? *Comput. Assist. Lang. Learn.* 2021, 1–24.
- [12] Musk, N. Using online translation tools in computer-assisted collaborative EFL writing. *Classr. Discourse* 2022, 13, 1–27.

- [13] Bowker, L. Chinese speakers' use of machine translation as an aid for scholarly writing in English: A review of the literature and a report on a pilot workshop on machine translation literacy. *Asia Pac. Transl. Intercult. Stud.* 2020, 7, 288–298.
- [14] Guerberof-Arenas, A.; Toral, A. The impact of post-editing and machine translation on creativity and reading experience. *Transl. Spaces* 2020, 9, 255–282.
- [15] Zhen, Y.; Wu, Y.; Yu, G.; Zheng, C. A review study of the application of machine translation in education from 2011 to 2020. In *Proceedings of the 29th International Conference on Computers in Education (ICCE)*, Electron Network, Bangkok, Thailand, 22–26 November 2021; pp. 17–24.
- [16] Cementina, S. Language teachers' digital mindsets: Links between everyday use and professional use of technology. *TESL Can. J.* 2019, 36, 31–54.
- [17] King, M., Cave, R., Foden, M., Stent, M. (2016). Personalized education: From curriculum to career with cognitive systems. *IBM Education*, 216–232.
- [18] Pan, X. Technology acceptance, technological self-efficacy, and attitude toward technology-based self-directed learning: Learning motivation as a mediator. *Front. Psychol.* 2020, 11, 564294.
- [19] Grossfeld, B. (2020). Deep learning vs machine learning: a simple way to understand the difference. Retrieved July 17, 2020, from: <https://www.zendesk.com/blog/machinelearning-and-deep-learning/>
- [20] Zhang, Q., Yang, L.T. Chenc, Z., Li, P. (2018). A survey on deep learning for big data. *Information Fusion*, 42, 146–157.
- [21] Holst, A. (2020). Volume of data/information created worldwide from 2010 to 2024. In *Statista - The Statistics Portal*. Retrieved July 25, 2020, from: <https://www.statista.com/statistics/871513/worldwide-data-created/#statisticContainer>
- [22] Rouse, M. (2011). Machine Learning Definition. Retrieved July 10, 2020, from: <http://whatis.techtarget.com/definition/machine-learning>.
- [23] Zhao, T. (2019). The AI Powers Behind Google Translate. CCTP-607: "Big Ideas": AI to the Cloud course. Retrieved July 29, 2020 from: <https://blogs.commonsgorgetown.edu/cctp607-spring2019/author/tz166/>
- [24] Dada, E.G., Bassi, J.S., Chiroma, H., Abdulhamid, S.M., Adetunmbi, A.O., Ajibuwa, O. E. (2019). Machine learning for Email Spam Filtering: Review, Approaches and Open Research Problems. *Heliyon*. 5(6), E01802, doi:<https://doi.org/10.1016/j.heliyon.2019.e01802>
- [25] Singh G., Srikant, S. & Aggarwal, V. (2016). Question Independent Grading using Machine Learning: The Case of Computer Program Grading. *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, San Francisco, California, 263–272.
- [26] Durdevic Babic, I. (2017). Machine Learning Methods in Predicting the Student Academic Motivation, *Croatian Operational Research Review*, 8(2), 443–461.
- [27] Dlabac, T., Milovanovic, A., Koprivica, B., Calasan, M., Janjic, M. (2019). Evaluation of internet-based practical teaching in higher education, *Proc. of the International Scientific Conference*, 15th–16th, November, 2019, Gabrovo, 3, 209–213.
- [28] Kawade, B., Ghrcem, P., Wagh, Dr. K., Pune, G. (2016). Data Analytics in Educational Management System. *National Conference on Advances in Computer, Communication and Networking*, ACCNet – 2016), Pune, Maharashtra, February 2016, 22–25.