Applying Artificial Intelligence (AI) in a Tutoring System for supporting students' English language learning in Hong Kong middle school

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Introduction

The current situation of Hong Kong can be regarded as an international and successful center which has a good reputation in commercial and financial fields in the Far East Asia Pacific area. As an megacity behemoth which is located on the southeast coast of China, Hong Kong only has about 1,100 square kilometers, but there are more than 6.6 million people, according to the related data released by Hong Kong researchers, 91.6% of the population is ethnic Chinese and the rest are different minorities including Indian, ethnic European, American, British and so on (Kwan & Lo, 2020). Nowadays, Hong Kong is a special administrative region, officially known as Hong Kong SAR, there are two official languages in Hong Kong SAR, English and Chinese. Under the combined influence of British colonial rule and Hong Kong's special status today, English plays an auxiliary role in Hong Kong language status, it can not be simply defined as a foreign language (Luke & Richards, 1982). English still in a significant position of Hong Kong business field, and higher education.

In Hong Kong, English education can start from kindergarten, in primary and secondary middle school, English will be taught as one of compulsory subjects which is as important as Chinese and Mathematics, in post-secondary education, Hong Kong universities stipulate English as the official medium of instruction.

Therefore, English education in Hong Kong is more important than other places in Far East Asia area. Meanwhile, Hong Kong exam-oriented culture put more pressures on both teachers and students. It can be seen that English education in middle school is in the middle position of connecting the previous and the following from the vertical perspective.

The 21st Century is an era of rapid development of science and technology, during this time, emerging techniques has made a significant influence on the learning process in language learning (Ahmadi & Reza, 2018). Modern techniques can be used into

providing solutions for Hong Kong English Education problems, such as relieving teachers' stress and assisting students on learning and practicing. Artificial Intelligence (AI) is one of the emerging technologies in the recent time, in its related fields, there is a sub field named Expert System (ES) which published since the 1970s, it is planned to solve professional problems in particular fields, for example, Medical Expert System is developed to provide professional treatment advice of different patients, doctors can make decisions depending on their solutions (Hetem, 2000).

Inspired by ES, this project is aimed to make a new tutoring system for improving the present English education in Hong Kong middle school. Different from traditional tutoring systems, the system of this project introduces a variety of AI related technologies, so that the system has more functions and is hoped to have a better performance in specified field. Based on the survey of students and teachers in this project, the article can make a preliminary evaluation of whether the system can meet the current educational needs and performance.

Literature Review

1. The English Language Education (ELE) problems in Hong Kong middle schools

English language education researchers were optimistic on the exploration of Information Technology (IT), they considered IT can be used into helping teachers and students, especially in classroom interaction and curriculum design, web-based teaching had opportunities to make a collaboration with English language teaching in Hong Kong (Lee, Jor & Lai, 2005). However, given the fact that Hong Kong middle school tend to adopt traditional chalk-and-talk classroom model, even though they may use some slides as supportive teaching materials, computer and IT are still limited in the classroom, in the meantime, Hong Kong English teachers prefer to assign paper

homework (Cheung & Ng, 2000). In the three years since the outbreak of the COVID-19 virus, Hong Kong English teachers still asked the students to finish their homework with paper and pen before taking pictures and uploading them to the teacher for grading, and the pictures will be checked by teachers manually.

In critical view, the present Hong Kong ELE has many deep-rooted traditions and was influenced by the hegemony of western teaching strategies and western model of education left over from the British colonial period, in the current Hong Kong middle schools' English curriculum designs, communication exercises section still has lots of westernized topics such as finding grandmother's false teeth, because of the culture isolation, Hong Kong local students feel boring and alienated so that they showed lower interest in English learning (Luk, 2005).

From the teachers' point of view, their workload may be one of difficult issue in improving Hong Kong ELE. With the increasing paper work for evaluation efforts from different aspects, especially evaluations of students' paper work, researcher (Lin, 2009) pointed out that teachers has less and less time to embark on innovative projects that making micro reformations on their teaching, for the same reason, they are not well prepared to adapt to the numerous curriculum reforms in Hong Kong, so they stubbornly follow the traditional teaching strategies and models.

Except that teachers, due to their heavy paper work, do not have enough energy to adapt to the reform and improve their teaching, students also face many challenges. As a former witness of English education in Hong Kong and an English teacher, Lee (2014) has enough experience to talk about the problems of English education in Hong Kong, she said that Hong Kong ELE had Target-Oriented Curriculum (TOC), it can be interpreted as exam-oriented curriculum design, thus, Hong Kong ELE kept a traditional manner: students' practice emphasized mechanical drills and exercises for forcibly memorizing vocabularies and grammar rules, grammar knowledge comes in

fragments and is used in training, but students rarely have the opportunity to use them in a comprehensive way.

Combined with the aforementioned cultural differences leading to the exclusion of students from communication exercises, Hong Kong students have much fewer opportunities for comprehensive training than traditional training. As a result, students only know grammar rules and words but cannot use them skillfully to form sentences or articles.

2. Traditional Tutoring System (TS)

In recent years, computers have become integral tools in education, providing support to both educators and students. Before the advent of Educational Software in the field of education, Computer-Based Training (CBT) was used as a series of systems that aimed to teach with the help of computer support. The second type of system was Computer Aided Instruction (CAI). However, these systems had certain limitations, such as the inability to meet individual student needs due to the temporal techniques employed. The instructional decisions were scripted, and did not take into account a student's specific abilities and learning needs.

While both CBT and CAI can assist with student learning to some extent, they have limited efficacy because they may not have enough abilities to provide individualized solutions for each student's learning condition. According to Beck et al. (1996), if a computer technology-based educational system is to provide individualized attention to each student, it must reason about both the education domain and the learner. This is where Intelligent Tutoring Systems (ITSs) come into play. ITSs have been developed to provide more flexible solutions in terms of teaching material presentation and responses to students' idiosyncratic learning needs. In other words, ITSs implement a curriculum or lesson design and make relevant pedagogical and instructional decisions automatically without pre-customization by developers of the system, unlike CBT and

CAI.

Since ITSs are designed to reason about the education domain and the learner, they have proven to be highly effective at supporting student learning. An example of this is the Smithtown Intelligent Tutoring System, which has demonstrated that students who learn economics using this system perform equally well compared to those taking traditional economics courses, but in only half the time (Shute & Raghaven, 1989). By leveraging automated reasoning techniques, ITSs can provide tailored learning experiences that adapt to each student's unique capabilities and learning needs. As a result, they represent a significant step forward in computer technology-based education systems and have the potential to revolutionize the way we approach teaching and learning in the future.

3. General Expert System

Research of expert systems (ES) is a branch of artificial intelligence exploration, ESs' basic theory support is that storing professional knowledge into a computer system, professional knowledge means a large amount of knowledge used to solve problems in a specific domain (Turban, 2001). ES can provide specific advices and solutions corresponding to clients' problems, they can flexibly and powerfully support professional projects like a human consultant. The following table is a brief introduction of ESs (Liao, 2005):

Academic Name	Description	Applications
Rule-based system (RBS)	An expert system that is based on rules can be characterized as one that incorporates knowledge acquired	Various fields including psychiatric treatment, teaching support, knowledge base maintenance, agriculture arrangement and scheduling,

	from a domain specialist and encodes this knowledge in the form of logical rules, typically in the IF-THEN format.	tutoring system, sensor control and so on.
Knowledge-based systems (KBS)	One frequently cited characterization of knowledge-based systems (KBS) underscores their human-centric nature, emphasizing that these systems are grounded in the discipline of artificial intelligence (AI) and constitute endeavors to capture and emulate human expertise within computerized frameworks (Wiig, 1994).	Including medical treatment, production planning, personal financial analysis, decision assistant, climate forecasting and so on.
Neural networks (NN)	An artificial neural network (ANN) is a	Applications include mitigation processes control, mining process

	computational construct that mimics the intricate functionality of its biological counterpart, the neural network. The advanced research topic, convolutional neural networks (CNN) will be mentioned in the following parts of the article.	design, robotic system developing and so on.
Fuzzy expert systems (FES)	Fuzzy expert systems are constructed through the utilization of fuzzy logic methodology, which proficiently manages the intricacies surrounding uncertainty.	Such as power load forecasting, chemical process fault diagnosis, uncertainly reasoning.
Intelligent agents	An Intelligent Agent (IA) is an autonomous computer program	Air pollution control, tutoring system design and analysis, system developing, industry

	designed to facilitate and streamline the execution of routine computing tasks by assisting and augmenting human users.	simulation.
Case-based reasoning	The fundamental concept underlying Case-Based Reasoning (CBR) is to leverage previously applied solutions for addressing current challenges by adapting and applying them as appropriate.	Power system restoration practicing, medical scheduling, medical application, electronic learning and knowledge model construction.
Ontology	Ontology can be defined as a formal and structured system of lexicon, which serves as a foundational framework to describe and represent the	Medical decision assistant, landscape evaluation, knowledge consultation and so on.

	domain-specific knowledge and tasks that need to be identified and analyzed within a given context.	

From the above review of ES research, it can be seen that ES has a large number of research and practical application cases in medical care, finance, education, including the tutoring system that this project focuses on (Tan & et al., 2016).

4. Natural Language Processing (NLP) applications

Natural Language Processing (NLP) constitutes a domain of scientific inquiry and practical implementation that delves into the frontiers of computer science with an endeavor to comprehend and manipulate human language in written or spoken form, for accomplishing varied objectives (Liddy, 2001). The primary aspiration of NLP researchers is to accumulate insights into the intricacies of human language comprehension and usage, and thereby devise suitable methodologies and mechanisms to enable computer systems to decipher and manipulate natural languages, so as to execute tasks that are intended (Chowdhary & Chowdhary, 2020).

NLP has found extensive applications across multiple domains of inquiry, ranging from automating machine translation and facilitating natural language text processing and summarization to enabling the development of user interfaces, supporting multilingualism, and enhancing cross-language information retrieval (CLIR). Furthermore, NLP has proven instrumental in advancing speech recognition capabilities and driving the development of AI and ESs. These are just a few examples of the myriad ways in which NLP is transforming the way we interact with and understand language (Nadkami & et al., 2011).

Therefore, in the project's system design, the application of NLP is commonplace, particularly with respect to the processing of information exchanged between educators and learners. A comprehensive survey of literature on NLP and Expert Systems (ES) reveals a wealth of examples where these technologies have been effectively integrated. Hence, this project will leverage NLP techniques in conjunction with ES as a foundational technology to augment communication experience and optimize information processing capabilities between the system and its users.

5. Machine Learning (ML) and its Convolutional Neural Network (CNN)

ML is a modern discipline concentrated on the methods of automatically improve computer system with enough mechanical practices, in the past two decades, ML has been considered as the first choice of developing models and software about Computer Vision (CV), speech recognition, NLP, robotic control and other derivative fields (Jordan & Mitchell, 2015).

ML is one of important methods developing English education tutoring system in this project. In ML, the most worthy technology to be mentioned is the convolutional neural network algorithm, because the most important algorithm for improving system performance in the system design of this project.

A Convolutional Neural Network (ConvNet/CNN) is a sophisticated Deep Learning technique that has the ability to analyze input images, identify critical features and objects within those images, and effectively differentiate them from one another. This process relies on the application of learnable weights and biases to various components of the image, a mechanism that offers significant advantages over traditional classification algorithms which typically require more extensive pre-processing.

Unlike earlier methods where filters were manually engineered, ConvNets are designed to learn these characteristic filters through a process of iterative training. This approach requires less pre-processing than comparable techniques, making it a highly efficient

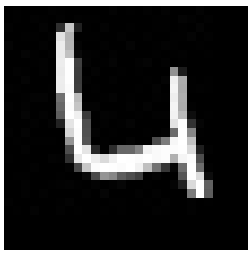
means of image classification (Albawi & Mohammed, 2017).

The architecture of a ConvNet is closely modeled on the connectivity pattern of neurons in the human brain, which was inspired by the organization of the visual cortex. In essence, individual neurons are programmed to respond only to stimuli within a specific region of the visual field, referred to as the Receptive Field. These fields overlap to cover the entire visual area, thus mimicking the neural architecture of the human brain. At a high level, the structure of a CNN consists of several layers, including input layers, convolutional layers, activated or sigmoid functions such as RELU layers, pooling layers, and fully connected layers. By leveraging this architecture, ConvNets have proven to be highly effective at solving complex image classification and recognition tasks (Katternborn & et al., 2021).

System Design

The project comprises two primary modules, namely the text recognition module and the essay scoring module. These modules work collaboratively to provide a range of services that recognize students' handwritten homework and automatically mark it.

The character recognition module is further divided into three distinct parts, namely, handwritten Chinese recognition, handwritten English recognition, and handwritten digit recognition. The handwritten digit recognition component utilizes MNIST as both the training and test sets. As the requirements for handwritten digit recognition are relatively low, MNIST is partitioned into a 70% training set and a 30% test set. The results of the training are presented in the figure below.



the handwritten number sample

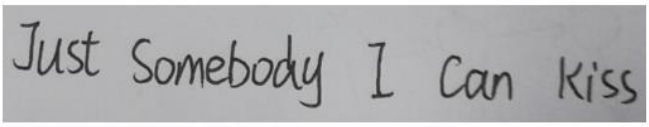
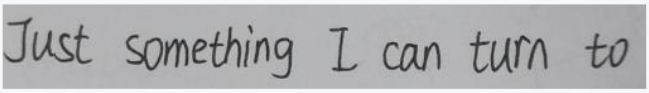
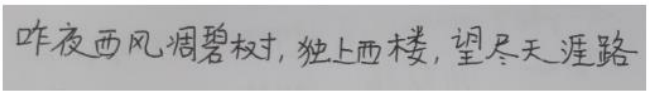
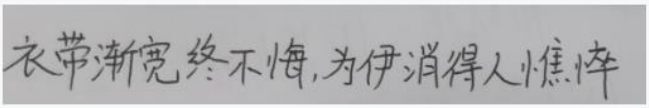
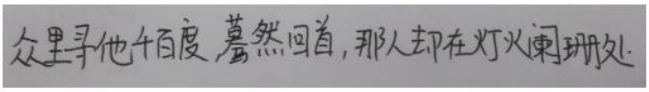
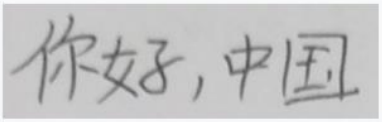
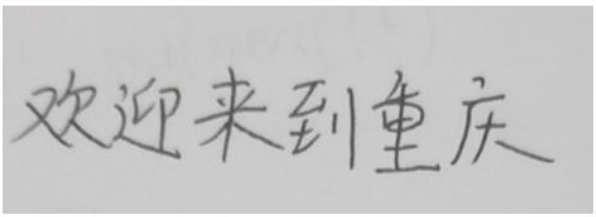
```
  %24 : Long(1, strides=[1], device=cpu) = onnx::Unsqueeze[axes=[0]](%22)
  %26 : Long(2, strides=[1], device=cpu) = onnx::Concat[axis=0](%24, %31)
  %27 : Float(1, 576, strides=[576, 1], requires_grad=1, device=cpu) = onnx::Reshape(%19, %26) # C:\Users\Nick Yin\Desktop\
  %28 : Float(1, 128, strides=[128, 1], requires_grad=1, device=cpu) = onnx::Gemm[alpha=1., beta=1., transB=1](%27, %dense.
  %29 : Float(1, 128, strides=[128, 1], requires_grad=1, device=cpu) = onnx::Relu(%28) # D:\Anaconda3\lib\site-packages\tor
  %30 : Float(1, 10, strides=[10, 1], requires_grad=1, device=cpu) = onnx::Gemm[alpha=1., beta=1., transB=1](%29, %dense.2.
  return (%30)

tensor([[-1.4238, -2.9659, -2.2387, -3.2846,  8.1445, -1.3983,  2.8410, -6.2022,
         -3.2195, -5.6500]], grad_fn=<AddmmBackward>)
tensor([4])
```

Test outcome

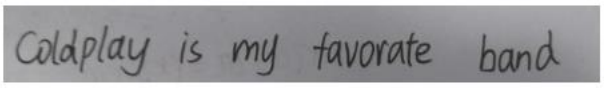
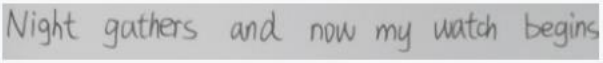
The aforementioned plot illustrates the performance of the Tensor-based model in predicting the number 4, achieving a 100% accuracy rate on the test set. However, it also reveals the over-fitting problem caused by the small number of samples and the use of the same data set for both the training and test sets.

To address this issue, multiple data sets are employed in the recognition of handwritten Chinese and English. Specifically, the SynthText and MJSynth data sets are used as training sets for English handwriting recognition, with the former containing 9 million synthetic text instance images from a set of 90k common English words. Conversely, as the system focuses on handwritten English recognition, the demand for handwritten Chinese recognition is relatively low, with the Chinese training and test sets obtained from CASIA-HWDB.

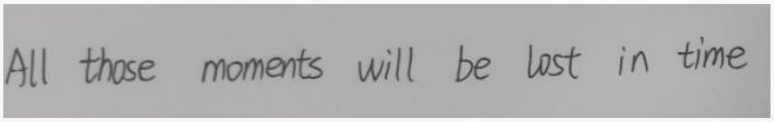
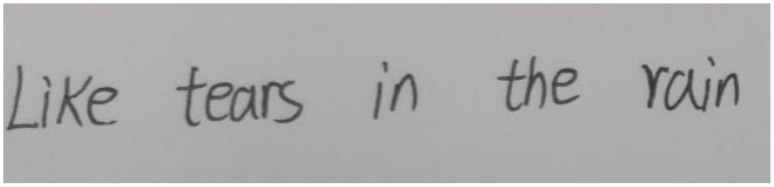
In the evaluation of the recognition system's performance, the IAM data set is utilized as the test set for handwritten English recognition, with a series of pictures presented below demonstrating both the Chinese and English handwriting recognition processes.

Image	GT	Prediction
	Just Somebody I Can Kiss	'Just Somebody I can kiss'
	Just something I can turn to	'Just something I can turn to'
	昨夜西风凋碧树，独上西楼，望尽天涯路。	'昨夜西风调瑟树,独上西楼。望尽天涯路'
	衣带渐宽终不悔，为伊消得人憔悴	'衣带渐宽终不海,为伸消得人憔悴'
	众里寻他千百度，蓦然回首，那人却在灯火阑珊处	'众里寻他千百度,暮然回首,那人却在灯火闻班然'
	你好，中国	'你好，中国'
	欢迎来到重庆	'欢迎来到重庆'

Test demo table 1

Image	GT	Prediction
	Coldplay is my favorate band	'Coldplay is my favorate band'
	Night gathers and now my watch begins	'Night gathers and now my watch begins'
	You konw nothing John Snow	'You konw nothing John snow'

Test demo table 2

Image	Prediction
	'I have seen things you people would not believe lift'
	'Attack ships on fire off the shoulder of Orien'
	'I have watch bearans gitter in the does near the Tarhouser'
	'All those moments will be lost in time'
	'like tears in the rain'

Test demo table 3

After the test data is collected and sorted out, the statistical data tables of English recognition and Chinese recognition can be obtained:

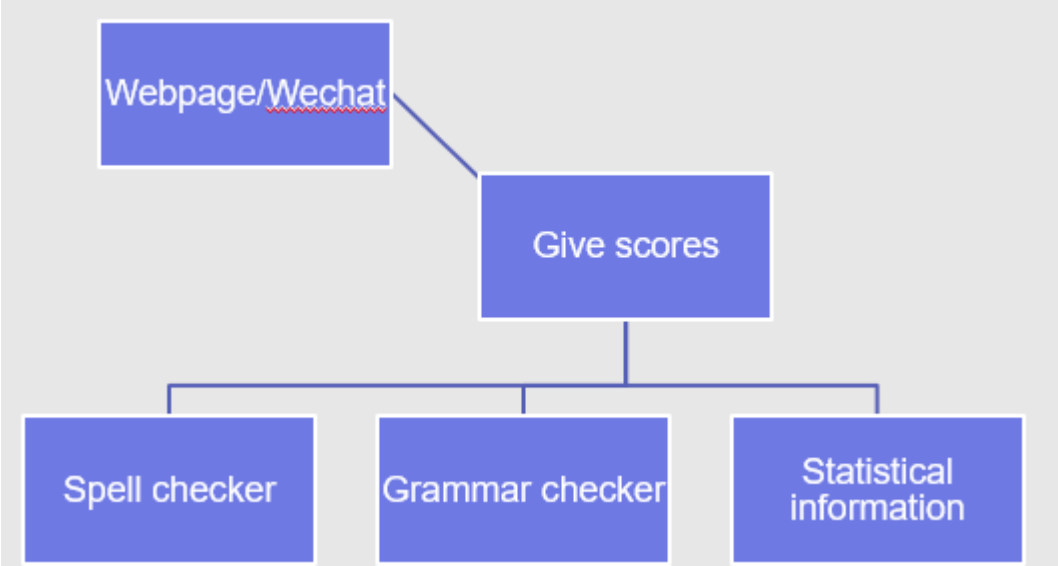
Dataset	**Word Accuracy**
IAM	**67.2**
CASIA-HWDB2.0-2.2	**88.6**

Similar to the digit recognition model, the Chinese recognition model also experiences an overfitting phenomenon due to insufficient sample size. Despite utilizing multiple data sets for training, the accuracy of Chinese recognition remains relatively low.

Moreover, the accuracy of digit recognition also exhibits an overfitting issue.

In contrast, the accuracy of English recognition is relatively higher, reaching more than 50%. However, it still falls short of the accuracy achieved by human text recognition, highlighting the need for further improvement in the recognition technology.

The architecture of the scoring module is shown in the following figure:

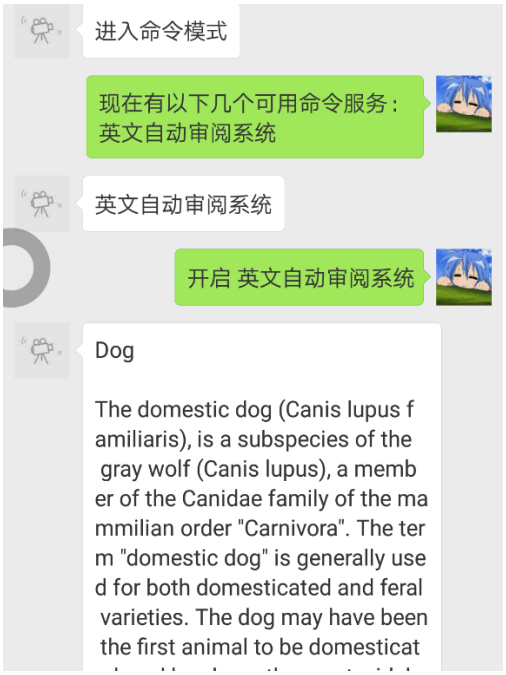


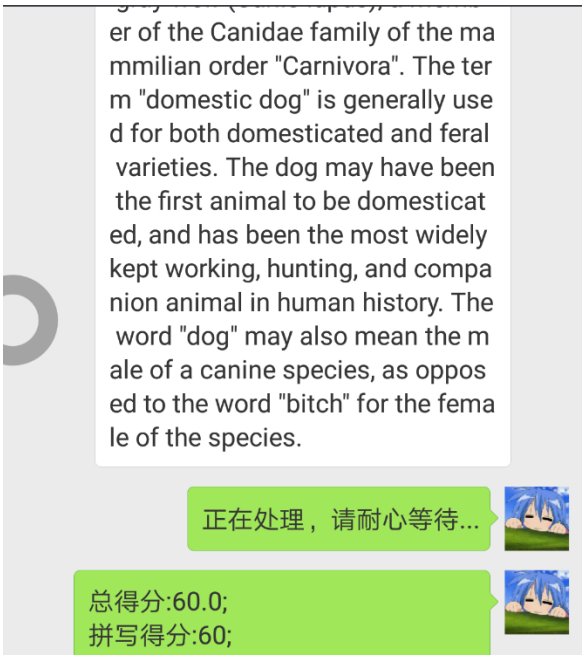
The evaluation of the essays in the system is conducted based on a comprehensive scoring algorithm that considers four critical factors. The first factor is the spell checker, which initially scans the essay for misspellings and then counts the frequency of advanced words, defined as words with eight or more letters. The system applies a penalty for misspelled words and a penalty for an inadequate number of advanced words.

The second factor is the grammar checker, which examines the usage of grammar in the essay. The system awards points for the correct use of relatively sophisticated grammar, such as clauses and the passive voice, while subtracting points for grammatical errors.

Subsequently, the data obtained from the four aspects are unified into statistical information, which is then integrated to provide the score feedback to the user. The system has been tested, and the results indicate its effectiveness in evaluating

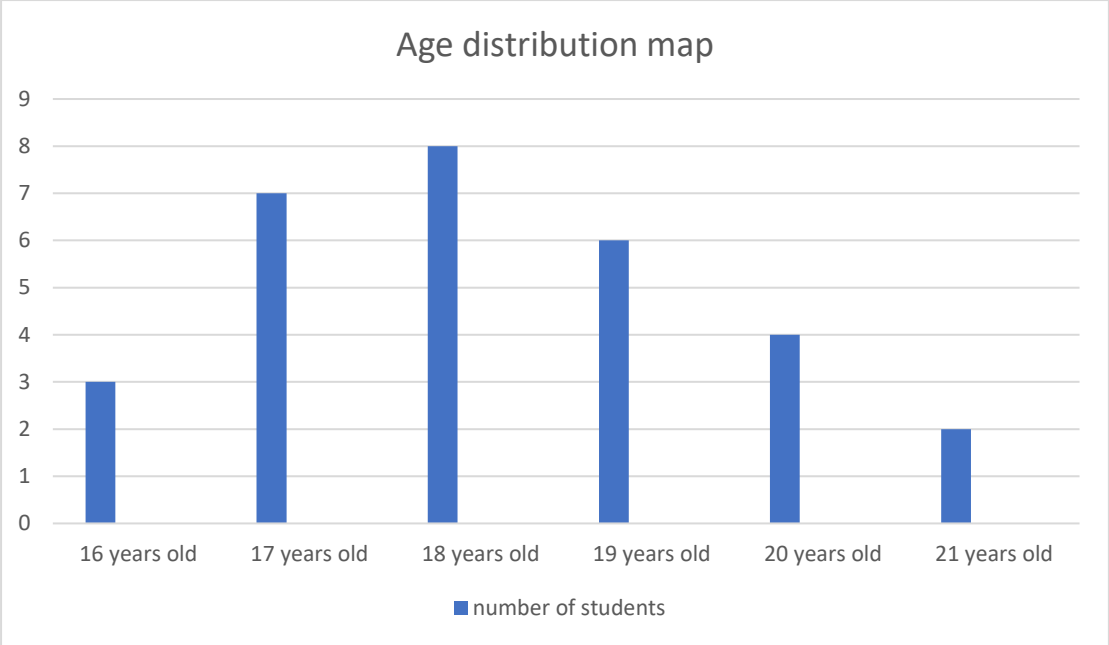
compositions.





Research Objectives

Research objectives include two groups, their data are collected by questionnaires and interviews separately. Questionnaire is for investigating the important point of English learning for English learners. In terms of questionnaire surveys, as this project focuses on English education in Hong Kong secondary schools, the surveyed students are mostly between 16 and 21 years old, who are currently receiving secondary education or have experienced it. Therefore, their feedback can more accurately reflect the views of Hong Kong students towards English learning. The specific age distribution is shown in the bar chart below.



The following table is the questionnaire:

Question	Type
What is your age?	Short answer question
Have you ever used English learning software before?	Multiple choice
How often do you use English software?	Multiple choice
Do you agree that practicing English writing is helpful to improve your comprehensive English literacy?	Multiple choice
Do you think vocabulary learning is important for English learning?	Multiple choice

A Likert scale is a widely used psychometric instrument that employs multiple categories to elicit responses from participants regarding their attitudes, opinions, or feelings towards a specific topic. In the realm of research, Likert-scale questionnaires are most commonly employed in studies focused on individual differences variables,

such as anxiety, motivation, and self-confidence. The utilization of Likert-scale questionnaires offers numerous benefits, including the ability to efficiently collect data from large samples, generating highly reliable person ability estimates, establishing interpretational validity through a variety of means, and facilitating integration with complementary qualitative data gathering techniques, such as open-ended questions, participant observation, and interviews. Consequently, such scales have become an indispensable tool for researchers seeking to investigate multifaceted phenomena while maintaining methodological rigor (Nemoto & Beglar, 2014).

Here are some questions in Likert-type scale, they are based on a common condition, their experience of using this English learning software, and answer the degree of agreement with the following items:

1. I really enjoy the process of learning with English software.'
2. I think the operation interface and instructions of this English learning software are clear and easy to understand.
3. This English learning software enables me to better understand the use of words, grammar and sentence structure.
4. I can reasonably use the various functions of the English learning software.
5. Compared with the traditional way of learning, it is more convenient for me to learn English using this English learning software.
6. Using this English learning software to learn English is less time and cost for me.
7. Using this English learning software has improved the efficiency of my English learning.

The interviewees in the survey can be classified into two groups: current bachelor students (intern teachers) majoring in English education at The Education University of Hong Kong who have undergone block practice, and in-service secondary school

teachers in Hong Kong with more than five years of work experience. This was designed to gain more views of Hong Kong secondary school English teachers on local ELE. Davis and other researchers (2015) claimed that block practices and internships were playing a crucial role in pre-service teachers' personal professionalism development. Pre-service teachers who have undergone a period of teaching practice typically possess a preliminary understanding of the subject they teach. Based on their advanced educational theory learned in university, they are more likely to propose innovative ideas that differ from the traditional perspectives held by in-service teachers (Trent, 2018).

The interviews with different teachers had the same six questions:

a) What do you find the most stressful part of everyday teaching?
b) From the perspective of educators, what is the current education mode?
c) Is the current education suitable for students?
d) What do you think is the main contradiction in English education today?
e) Do you think having an AI system that can help you grade student work or even grade essays would help improve current teaching?
f) For this system, do you have more expectations and suggestions for modification?

There are four teachers participating in this interview, two of them are in-service teachers at the school, and the other two are bachelor students in the Department of English Education of Hong Kong University of Education. Since they do not want to disclose their real names, we name the first two as A and B, and the last two as C and D.

Research Methodology

Quantitative inquiry represents a research framework that underscores the quantification and systematic analysis of data. Adhering to a deductive approach, this

method prioritizes theory testing within the context of empiricist and positivist philosophies (Bryman, 2016). Quantitative data is characterized as any form of data that can be represented numerically, including statistics and percentages. Its analysis often involves the use of statistical methods to extract meaningful insights, with the ultimate aim being to arrive at an unbiased and generalizable result that can be applied to a broader population (Glesne, 2016).

In the project research, the quantitative data has been collected by questionnaires from the students, there are results of 30 questionnaires which can be used into data analysis. Statistics is a crucial field of mathematics that plays a pivotal role in quantitative research, extending beyond the physical sciences to encompass other areas such as economics, social sciences, and biology. In essence, the application of statistical methods serves as the bedrock upon which various fields derive meaning from data. The process of quantitative research using statistical methods typically commences with the collection of data based on some hypothesis or theory, often utilizing a large sample size that must be verified, validated, and recorded before any meaningful analysis can take place. In practice, software packages like SPSS and R are commonly employed to facilitate this crucial stage of the research process (Moghaddam & Moballeghi, 2008). This project has processed quantitative data through Qualtrics, which is an application can generate, publish, and distribute questionnaires.

The important questions of the questionnaire include seven sub questions in the Likert-type scale and the last two questions in multiple choices, the main purpose of the questionnaire is to investigate students' concentration in English learning, and their opinions on English learning software and systems.

On the other hand, Qualitative research is a distinctive form of inquiry that strives to amass and scrutinize non-quantitative (narrative-based) information with the aim of comprehending the social environment of individuals. This process encompasses

examining their attitudes, beliefs, and motivations, among other subjective elements that constitute their lived experiences. By gathering descriptive data in this manner, qualitative researchers can elicit insights into the complex nature of social phenomena, which may not be readily captured by statistical measures alone (Elizabeth, 2008).

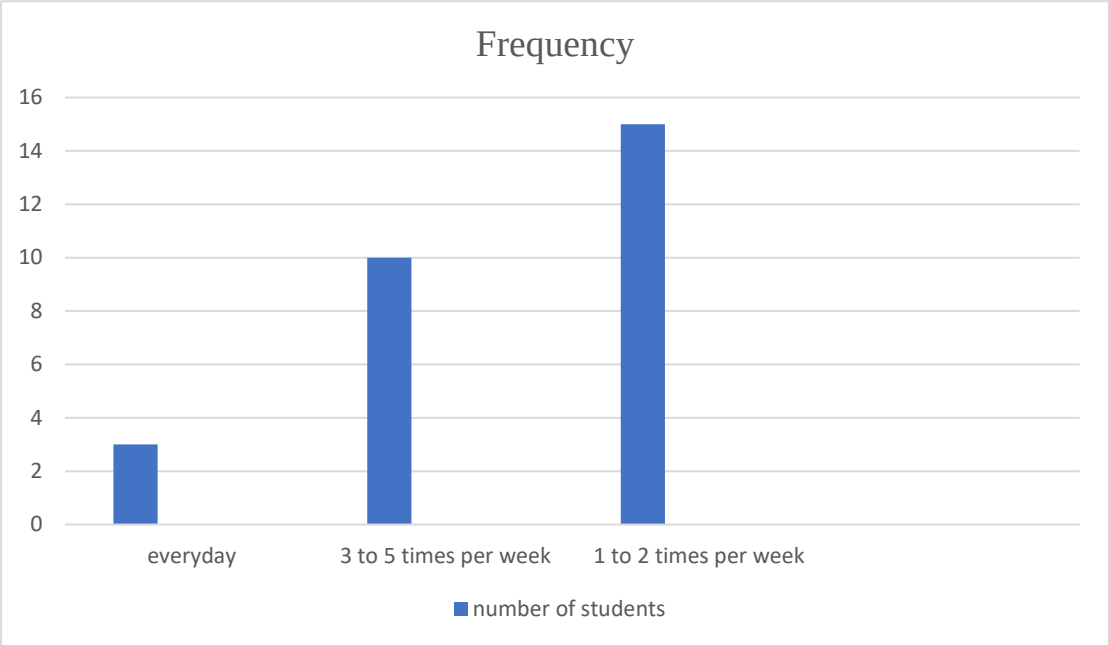
In the research plan, qualitative data is collected from interviews with the four teachers. Interview research is a pivotal means of gathering data in qualitative research, whereby an interviewer, who may be a specialist or remunerated researcher with formal training, solicits responses from the interviewee through a series of iterative questions and answers. Unlike written surveys, qualitative interviews offer a more profound level of personal connection between participants and interviewers, frequently leading to the disclosure of sensitive information in real-time and during face-to-face interactions. Consequently, this methodology can elicit a diverse range of emotions and experiences among those being interviewed (Seidman, 2006).

The questions in interviews are focusing on understanding teachers' stress and attitudes towards current ELE problems, and investigating whether the project can provide supportive power to solve them. The qualitative data will be used into content analysis in the analysis part.

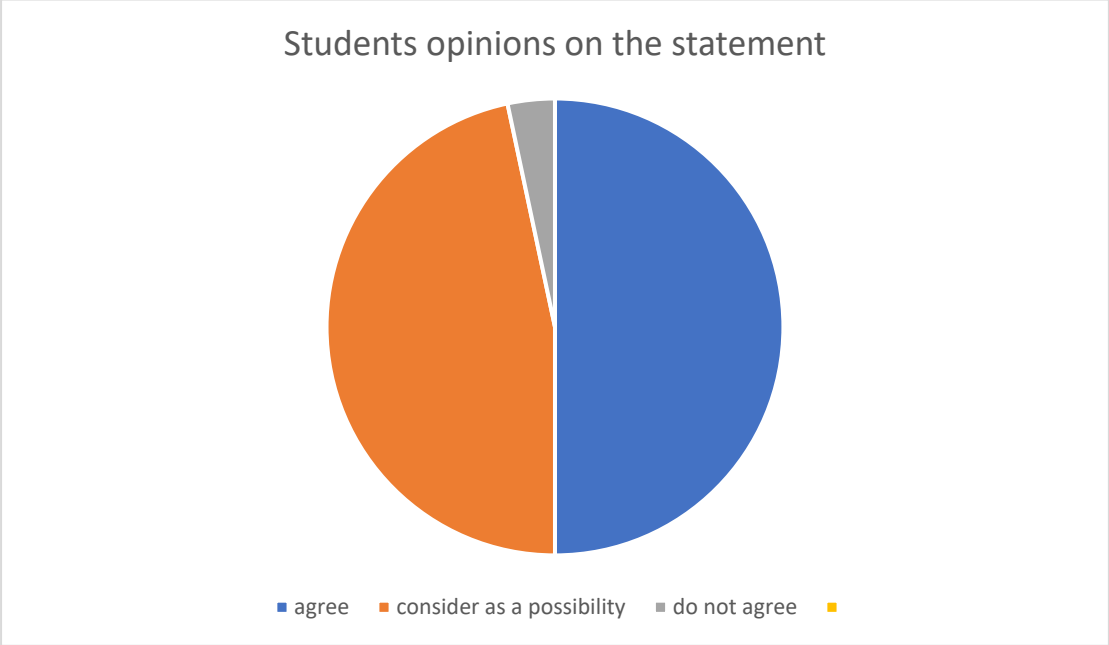
As stated by Krippendorf (2018), content analysis stands as a methodological approach that facilitates the development of reliable and substantiated conclusions from data sets in relation to their environmental framework. This investigative technique is notably employed within the realm of written and verbal communication, as well as document analysis. The significance of content analysis lies within its foundational role in the conceptual investigation of qualitative data, with its use being observed across various fields, including sociology. An illustration of its diverse application can be seen in studies that analyze the transformation of racial perceptions over time or the examination of contractors' lifestyles (Morning, 2008).

Result

For quantitative data collected from questionnaires, there is a bar chart for performing the frequency of using English learning software:

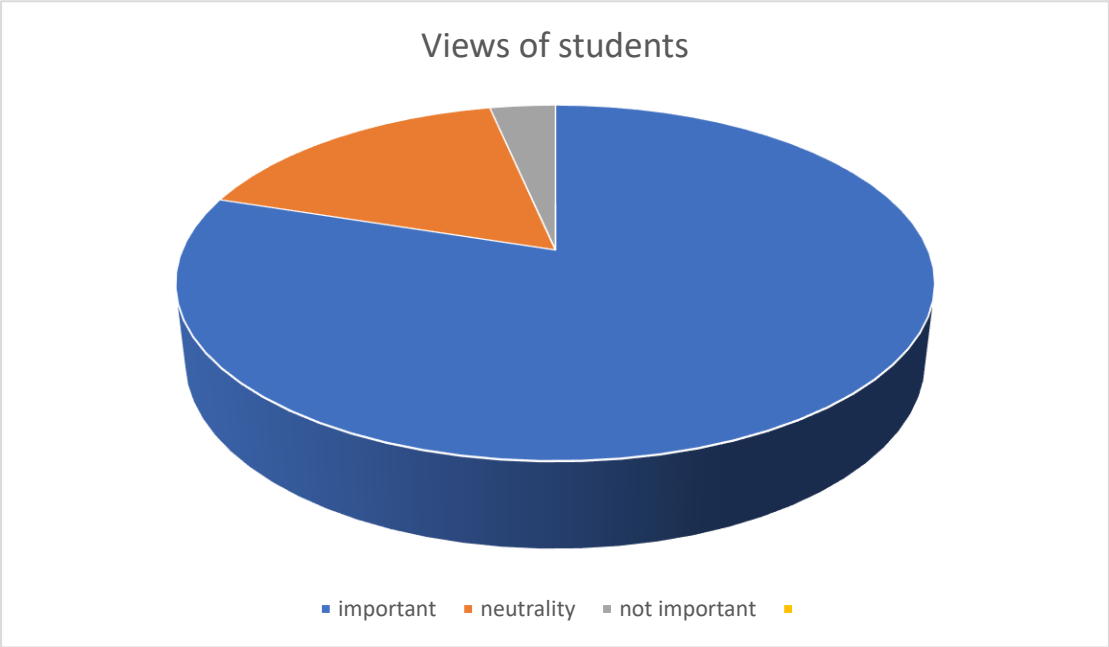


The pie chart below shows students' views on whether more practice in English writing can improve their comprehensive English literacy:



There are 15 students totally agree the statement, and 14 students think more English composition exercises may be helpful for improving comprehensive English skills, only one student do not agree that.

The question about the importance of vocabulary in English learning has similar situation, 24 students consider vocabulary is an important section in ELE, its pie chart has been provided below.



As per the outcomes derived from the Likert scale, it can be inferred that students possess a considerable interest in software and systems employed for learning the English language. Despite their keenness, they demand a more lucid and user-friendly interface. Furthermore, English e-learning holds an edge over conventional pedagogical approaches due to its higher efficacy and lower time and financial costs. Additionally, the courseware developed by the project is believed to facilitate a comprehensive transformation of students' English proficiency, including but not limited to, lexical competence, grammatical accuracy, and syntactical fluency.

In terms of quality analysis, since there is no specific data to be collected, the interview content of the four interviewees will be summarized as their comprehensive views on each issue in the interview.

Based on the insights gained from interviews with individuals A and B, it is evident that the English teachers in Hong Kong secondary schools are confronted with significant pressure originating from voluminous paperwork, specifically the daily task of correcting homework. As a result, they struggle to allocate sufficient mental and physical resources to developing new curriculum materials and designs that align with the recent curriculum reform in Hong Kong. To acquire new teaching methods, these educators can only participate in workshops during weekends. Conversely, young student teachers such as C and D do not encounter comparable pressures stemming from curriculum reform. Rather, their primary concern revolves around assimilating into the teaching ambience and adjusting to the instructional methodology of the institution. Consequently, the extensive grading undertaken by supervisory teachers impedes their progress and intensifies their stress levels.

Upon utilizing the system devised by this project, divergent assessments have emerged among the participants. Teachers A, C, and D contend that this system could potentially aid educators, abate their workload associated with paperwork, and furnish them with additional time to enhance pedagogical strategies and curricular development. Conversely, Teacher B has articulated concerns regarding the efficacy of such a system in assuring the accuracy of students' homework. While acknowledging the potential benefits for bolstering students' overall English proficiency, he apprehends that without adequate technological infrastructure to ensure the veracity of the system, instructors employing this technology would be constrained to expend greater efforts reviewing student assignments, which could ultimately exacerbate rather than ameliorate teacher stress levels.

Analysis

Hong Kong ELE problems can be concluded in three aspects: for students, lacking practice in integrating various aspects of English language knowledge limits their developments of comprehensive skills in English literacy; in teachers' opinions, plenty of paper work prevents them to improve lesson plans and teaching designs, so that they are not given enough space to adapt to the curriculum reform; in terms of curriculum design, traditional lesson model emphasizes teachers' demonstration by chalk writing and oral expression, the barriers of instructional strategies make the present Hong Kong ELE difficult to integrate IT technologies deeply (Evans & Morrison, 2011).

Despite the widespread application of tutoring systems in education, many such systems lack the requisite functionality to assist educators with administrative tasks (Vanlehn, 2011). While most tutoring systems prioritize offering macro-level support for educational decision-making, they often fall short in their ability to alleviate the burden of paperwork on teachers.

In the questionnaire survey, more than 80% students have no objection on composition practices can improve overall abilities in English, including vocabulary, which is regarded as an important part of English language learning.

According to a study conducted by Ko and his research team (2015), students in the field of library and information science from Hong Kong, Japan, and Taiwan primarily use smartphones for social, leisure, and search purposes rather than academic activities. Furthermore, these students tend to avoid reading lengthy materials on their mobile devices. Another research conducted on Japanese undergraduate and postgraduate students regarding their educational usage of mobile devices found that the extent of using such devices for educational purposes heavily relies on individual learning patterns (Lau & et al., 2017). While the most frequent usage was for searching, the least

common usage reported was for reading.

Most scholars believe that the current conditions cannot guarantee that students can fully study in the e-learning environment, and the traditional classroom mode and homework mode will still exist for a long time.

The project system design concentrates on providing possible solutions for Hong Kong ELE problems which cannot be solved by general traditional tutoring systems. An inherent traditionalism in the Hong Kong secondary education system coupled with limited control over electronic devices make it unfeasible for English educators to swiftly shift from conventional homework methods to e-learning. Therefore, paper-based assignments must still be preserved. Nonetheless, this system's text recognition capabilities facilitate the conversion of physical homework submissions into digital output, providing a means for teachers to automate the grading process either within the platform or by exporting the output to other applicable software. Through such transformation, this system can reduce the pressure of teachers with IT technology without destroying the original chalk-and-talk teaching mode.

In the realm of EFL (English as a foreign language) learning, learners who are engaged in honing their writing proficiency often encounter several hurdles. Such hindrances may include but are not limited to an inadequate lexicon, deficient familiarity with the subject matter, and challenges in effectively articulating their thoughts. In order to alleviate this persistent issue, researchers have made substantial strides in the field of computer-assisted language learning (Shih, 2006). Through the use of IT technologies, this innovative approach aims to augment learners' content and linguistic comprehension, thereby facilitating more effective writing competence (Liu & Tsai, 2013). In the system, composition marking module can support both teachers' work and students' learning, on the one hand, students can use it to provide feedback on their own composition. In addition to the composition, because there is no requirement for the

length of the essay, it can also correct students' short essays, casual literary notes or single sentences. On the other hand, the module can provide reference when teachers grade a composition on a test paper or homework assignment.

Discussion

From a critical point of view, the system designed by this project can be improved in order to provide more possible solutions to the existing problems of English language education.

a) Accuracy

Based on the insights extracted from interviews with educators, it can be inferred that the efficacy of text recognition constitutes a pivotal factor in determining the system's ability to furnish teachers with practical assistance. In the event of suboptimal accuracy levels, instructors are compelled to invest additional time in verifying students' work, thereby rendering the system redundant. From the existing test data, although the accuracy rate of the two data sets selected for the text recognition test is much higher than 50%, the accuracy rate of IAM data set is only less than 70%, which is obviously lower than the standard of manual text recognition. The optimization of the system should start from data collection (Dijkstra & et al., 2019). If conditions permit, more students' handwritten samples should be introduced into the data set to achieve higher accuracy. The optimization of the technical level should use more advanced algorithm models, such as Convolutional Recurrent Neural Network (CRNN), CRNN is a convolutional recurrent neural network structure, which is mainly used for end-to-end recognition of variable length text sequences. It does not need to cut a single word first but converts text recognition into a time-dependent sequence learning problem, that is, sequence recognition based on images, in the actual life scene, CRNN has better performance than CNN in the text recognition of images in the case of interference

problems such as irregular text (Chen & Yang, 2020).

b) User Interface (UI) design

UI is no longer only a tool for using system but can be regarded as a framework for exploring contents in the system, as the significant field of Human Computer Interaction (HCI), UI improvements effectively improve the user experience with minimal cost (Blair-Early & Zender, 2008). From the data collected by quantitative analysis, most of the students think that the system needs a concise and easy to operate user interface. The UI will be designed around the two themes of simplicity and clarity, and a specific teaching process will be designed in future system optimization to provide guidance when users use the system for the first time, so that users can get familiar with the system faster.

c) More development for solving Hong Kong ELE problems

It has been mentioned in the previous article that Western educational hegemony leads to the incompatibility between English language education and local culture in Hong Kong, which makes students feel alienated or even disinterested in English (Boyle, 1997). In the future, ChatGPT-like communication capabilities will be developed to learn the local culture of Hong Kong through dialogue training with students and teachers, and to generate curriculum design and exercise arrangements adapted to local students. ChatGPT is a system developed by OpenAI laboratory and published in 2022, which is aimed at training a chatbot through supervised and reinforcement learning (Roose, 2022).

In order to realize the functions of communication and design questions, the system must first be developed with the function of networking, so that the data of each user can be collected to the remote database for research and analysis.

Conclusion

With the advent of rapid advancements in AI technology in recent years, researchers in the field of education have begun exploring its practical applications. While IT technology has been used to develop tutoring systems that aid in teaching and learning, Hong Kong's secondary schools have yet to fully embrace the use of computers in English lessons. This lack of e-learning environment significantly limits the support that tutoring systems can provide to both teachers and students.

Hong Kong's English education system has been heavily influenced by British and other Western education systems, and English has become a vital language in the region due to Hong Kong's status as an important international trade and financial center (Chen, Zou & Xie, 2020). As one of the official languages and characters of Hong Kong, English is widely used in daily life, creating a significant and widespread need for English language learning.

While the education system in Hong Kong has undergone many reforms aimed at improving the teaching of various subjects, including English, excessive paper workload has prevented teachers from adapting to these changes, and traditional mechanized training has limited students' comprehensive abilities (Pun & Macaro, 2019). Additionally, composition practice is valuable for improving English literacy, but the workload of correcting compositions places a burden on teachers, making it difficult to provide students with sufficient opportunities for composition practice.

To address this issue, this project has developed a handwriting recognition function that converts handwritten content into digital information, enabling automatic correction of handwritten homework in the computer. The marking module of the system provides teachers with a preliminary score of student compositions, while students can use the system to self-check their work. By providing support for teachers and students in ELE through the functions of text recognition and essay scoring, the system reduces teachers' workload and gives students more opportunities to learn independently. As the system

continues to develop, it will be able to address more ELE-related issues.

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Appendix

Interview materials:

Interview for A:

Background: Teacher A is an English teacher in one of band 3 middle schools in Fanlin, he has taught for six years.

Q: What do you find the most stressful part of everyday teaching?
A: In fact, the main work pressure is the workload is too heavy. I am responsible for English teaching of five classes alone, in addition to a few part-time classes of religious courses. It is too time-consuming to face the homework of students in five classes every day.
Q: From the perspective of educators, what is the current education mode?
A: In fact, the current teaching mode is still the teaching method based on my dictating before. We often want to give students some fun topics to do activities such as English corner and reading conference, but because the curriculum is tight and our teachers do not have so much energy to organize these activities, these activities have not been organized.
Q: Is the current education suitable for students?
A: I think it is appropriate for some students, such as those students who have a weak foundation, they must ask us to use tough methods to help them remember words and grammar, otherwise those students will have a lot of problems even spelling words, let alone oral expression.
Q: What do you think is the main contradiction in English education today?
A: The main contradiction is that now our teachers want to try new curriculum design with the curriculum reform, but they are unable to do so. Our energy and time are fixed, and meetings and homework correction take up too much of it, so there is no way to do more innovation.
Q: Do you think having an AI system that can help you grade student work or even grade essays?
A: I think this system is still very new and attractive to me, because the function of automatic correcting homework is really needed uld help improve current teaching?

Q: For this system, do you have more expectations and suggestions for modification?
A: I think we need a user interface, now the demonstration of the system is carried out on Pycharm, if there is a mature software with UI, it will be easier to use.

Interview for B:
Background: Teacher B is an English teacher in one of band 2 middle schools in Taipo, she has taught for ten years.

Q: What do you find the most stressful part of everyday teaching?
A: In terms of daily pressure, I think the biggest problem is that the school gives teachers too many tasks outside teaching. As a head teacher, I have a lot of chores to deal with, which makes me busy with some meetings and student problems outside teaching every day.
Q: From the perspective of educators, what is the current education mode?
A: At present, it is mainly based on the traditional teaching method of reciting words and grammar. Although it has been criticized for a long time, I think this teaching method can benefit all students in actual teaching and take into account the differences of students.
Q: Is the current education suitable for students?
A: Some are appropriate, and some are not. The teaching effect still depends on the individual differences of students, but it is a fact that most students are not interested in English learning.
Q: What do you think is the main contradiction in English education today?
A: I feel that the main contradiction is that students do not like the current rigid teaching, but teachers are also limited by tasks other than teaching and cannot improve teaching.
Q: Do you think having an AI system that can help you grade student work or even grade essays?
A: I still have some concerns about this system, because I think if the system makes mistakes, the responsibility should be attributed to the teacher, the teacher has to re-check the students' homework to ensure that there is no problem, so if the system can not ensure a high accuracy rate, the pressure on the teacher will only be greater.
Q: For this system, do you have more expectations and suggestions for modification?
A: As the previous question said, a high accuracy of the system should be a proof of the reliability of the system, I would like to have a higher accuracy.

Interview for C:
Background: Teacher B is a fourth-year student of English education department who has experienced block practice once.

Q: What do you find the most stressful part of everyday teaching?
A: During my internship, the biggest pressure was correcting homework. I had to help the teacher correct the homework of 8 classes, and almost all of my usual time for preparing course materials was occupied by correcting homework, so I had to go home after work to do course materials, and I even wrote the course design for the visiting class of the university supervisor overnight.

Q: From the perspective of educators, what is the current education mode?
A: I think the current teaching mode is still teacher-centered. I once tried a student-centered teaching strategy, but the effect was not good, because the behavior of students breaking the classroom discipline was completely out of control.

Q: Is the current education suitable for students?
A: I think I personally prefer to stimulate students' intrinsic interest in learning. The current teaching mode is a little too boring for students.

Q: What do you think is the main contradiction in English education today?
A: I am a student, I think this kind of problem I can only speculate, the main contradiction is that the teacher's teaching method does not meet the interests of students, exam-oriented education and forced teachers to maintain such a teaching method.

Q: Do you think having an AI system that can help you grade student work or even grade essays?
A: I think this system is very creative. I haven't had much contact with IT technology before. I didn't expect to have such advanced technology, which should help teachers reduce a lot of pressure.

Q: For this system, do you have more expectations and suggestions for modification?
A: I think it would be better to have a better UI, so that it can attract students, can stimulate students' curiosity, and then let students be interested in learning with this system.

Interview for D:
Background: Teacher D is a fifth-year student of English education department who has experienced two block practices.

Q: What do you find the most stressful part of everyday teaching?
A: The biggest pressure of the two internships was that the supporting teacher gave me too many tasks, mainly because they had a lot of affairs to deal with, so they would assign me such tedious tasks as correcting homework, which made me under great pressure.
Q: From the perspective of educators, what is the current education mode?
A: When I was in middle school, teachers still asked me to recite words, recite grammar and do some mechanical training. The class was mainly lectured by the teacher, and students only needed to take notes and understand the teacher's words. Now, there is not much change.

Q: Is the current education suitable for students?
A: I didn't like it when I was in high school, and I'm sure students today won't like it either

Q: What do you think is the main contradiction in English education today?
A: I think the main contradiction is that students and teachers do not understand each other. Students think that teachers are boring and do not know how to innovate, and teachers think that students do not listen to class carefully and do not study hard.

Q: Do you think having an AI system that can help you grade student work or even grade essays?
A: At least it is very helpful for me, the function of correcting homework really reduces a lot of work for me, and it also allows students to practice their English writing. I think it is a good system.

Q: For this system, do you have more expectations and suggestions for modification?
A: I think it would be a much more attractive system if it could communicate with the teacher like a chatbot, understand the needs of the teacher, and change the grading criteria based on the teacher's instructions

Source codes:

https://drive.google.com/drive/folders/1yFLnSS3Sc0RbLdggcZyk3t90oThujvXO?usp=share_link