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Artificial Intelligence – scary paradigm shift or opportunity to evolve?

Seán Timon

University of Oxford, Oxford, United Kingdom

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Abstract

This feature article sets out to offer some ideas and provoke discussion on the future of Artificial Intelligence Large Language Models in language education. The brief I was given is simple, to draw on my own observation, understanding and experience to set out a positive take on the development of AI Large Language Models in the education sector. So, caveat lector, this is not written from a neutral perspective, all opinions are my own unless stated otherwise.

I've set out to offer a brief survey of the major opportunities AI presents for language learners and teachers. These include an expansion in capacity and types of practice, support for the study environment and the roles of student and teacher. I set out a vision of a disruptive but ultimately beneficial impact on major aspects of language learning such as assessment and access to instruction. I have concluded by reflecting on the continuity and future possibilities of deep and ubiquitous AI augmentation of human language use.

Keywords AI, artificial intelligence, large language models, natural language processing, language learning, educational technology, future of language learning

I tend to hold the view that if you think AI can replace you as a teacher, you might be right. However, this article aims to encourage the hope that there is still a place for human teachers in the future.

1. Introduction

In my own teaching practice and research I've tried to make a distinction between playing around with AI, mainly by having debates with ChatGPT at 2am and drawing pictures of novel, movie and TV characters in unfamiliar situations, and trying to understand what AI can do that is relevant to language teaching and learning.AI can definitely write and grade essays, it can produce and respond to poetry, it can play a lot of language based games that you might use in the classroom. It can even do some things that some teachers and learners can't or won't - it can appear to listen carefully and change its mind. It can also cooperate in a way that almost matches my experiences with some of the very best human teachers I've had the pleasure of working with. Please hold that "almost" in your mind, it's going to be important later.

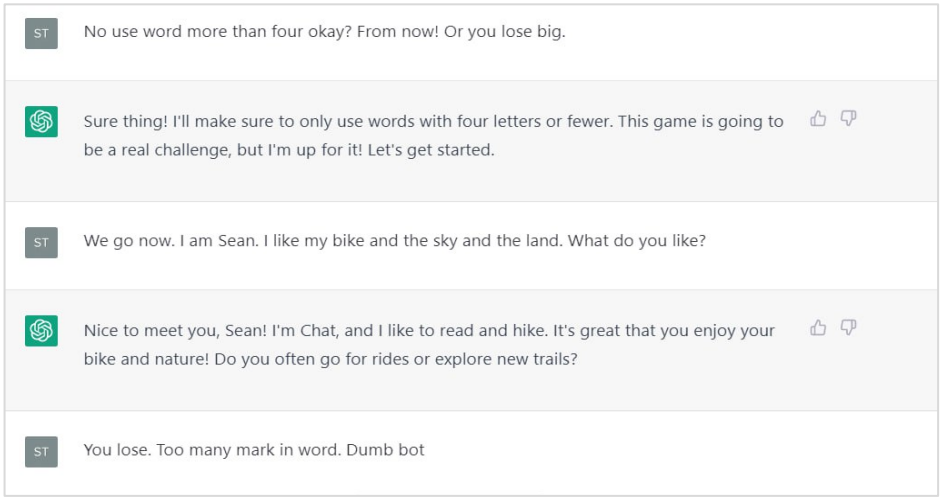

Figure 1. Chat records between the author and ChatGPT.

While there is definitely strong evidence on both sides of the debate about the positive or negative impact of AI on language education, these sides are not as polarised as might first appear to be the case – nobody seems to disagree about the transformational impact of AI in language education. Huge challenges are posed by AI integrating with the profoundly human field of education (leaving aside the bigger question of whether AI is a step towards the end of our species as we know it). I choose here to assume that we will recognise and respond to these challenges. I believe that we will reflect, mitigate, adapt, and to some extent fail, as part of the cycle of improving how we face change. I choose to believe this because it seems clear that the opportunity offered by AI far outweighs the threat. Paradigm shifts have always seemed scary, always contained implicit threat, and generally appeared inevitable with hindsight. AI can deliver enhanced learning experiences that transcend the current status quo, so logically a new balance between progressive and conservative forces will be negotiated. This process will likely be equally uncomfortable and exciting.

2. AI's Analytical Power

The power of an AI Large Language Model (LLM) lies in its ability to read vast amounts of linguistic data swiftly and accurately. Natural Language Processing (NLP), a subset of AI, enables machines to understand, interpret, and respond to human language. By analysing language structures, AI identifies patterns in speech/text, syntax, and grammar. For instance, an AI language application or plugin can identify and highlight common grammatical errors in learner sentences and offer targeted exercises for improvement. AI also offers the possibility of real-time feedback for language users. An AI-powered app offers the possibility of instantly identifying pronunciation errors, suggesting corrections, and modelling pronunciation through a real-time conversation. This personalised approach could in time develop to the point of maintaining an optimal level of challenge, preventing learners from feeling overwhelmed or under stimulated. AI-driven language platforms can create immersive and responsive environments that facilitate practical language use. Learners can engage in simulated conversations with AI characters, replicating real-life scenarios. These interactions enable learners to apply language skills authentically, bridging the gap between classroom learning and real-world communication. The opportunity here is for a widely accessible language partner for speaking practice, around the world, 24 hours a day, the impact on accuracy and fluency in language learning is literally incalculable. Of course, there are attendant questions – will the remaining barriers to accessing this technology deepen existing inequalities? Will the convenience of technological solutions lead to learners preferring language practice mediated by devices rather than the challenge of unpredictable and risky human interaction? As AI advances, ethical considerations are being increasingly highlighted in the attendant debate. This necessitates serious discussions on data privacy, AI bias, policy, governance and enforcement structures, and equitable access to education. Educators will play a vital role in shaping these conversations, ensuring that AI technologies are harnessed responsibly to create a fair and inclusive learning landscape. These issues appear to be of real concern, but not insurmountable if we choose to bring focus and resources to them in the service of community and individual values. Ultimately these are questions of social conscience, political will, and underlying economic structures as well as technological ethics.

3. Enhanced Learning Experiences Through AI

A key advantage of AI is the ability to adapt to learner needs, ensuring challenges that match their proficiency levels and facilitating a dynamic learning journey. Imagine an AI language app that focuses on pronunciation, powered by the most complex library of human language ever built. As a learner practices speaking, the AI analyses their speech and identifies areas for improvement. It might detect specific sounds that are challenging for the learner and offer targeted exercises to enhance their pronunciation, it might be able to compare the individual learner profile with a pattern library based on their L1. AI's analysis goes beyond individual words. It can evaluate the flow of sentences and the natural rhythm of conversation. For example, if a learner's sentences sound disjointed, the AI can suggest techniques to achieve smoother transitions between words, resulting in more fluent speech.

This level of personalised feedback allows learners to address their own unique linguistic needs. In my own teaching practice, to the limits of my modest ability, I have always found that bringing learners into the process supports their progress. Learners are often fascinated and engaged as they develop their understanding of the methods that underlie language practice. The potential of AI to develop these individual profiles and inform language teachers and learners is undeniable. However, as noted previously, the question of the impact on the relationship between learners, teachers and language users will be raised to even greater prominence. In a world where everyone with a mobile phone and an internet connection has access to the most comprehensive linguistic data set ever created, and an intelligence focused on their specific needs, what will human teachers be for?

AI-enabled adaptive immersion will certainly be one of the biggest opportunities offered by LLMs. Learners will engage in dialogues with AI characters set in various scenarios, such as ordering food in a restaurant or asking for directions. These interactions will closely resemble real-life situations, providing learners with valuable experience in practical language use. As learners respond to AI characters, they will receive instant feedback on their choices, helping them to better realise the subtleties of conversational language. This will no doubt be a huge shift from the current state of the automatic translation art, but it does lead one to wonder whether an AI LLM will ever bridge the gap between "almost human" and human. Human language is possibly the most complex, chaotic system we've ever produced, and it seems that there remains, for now a clear distinction between "intelligent"

and "conscious". Language models respond to prompts by using incredibly complex statistical models, vast data sets, and technical processes like "backwards chaining", so let us accept that AI LLM's pass the test for intelligence. However, it does not follow that AI's are currently conscious, we do not have evidence that they have experiences. This seems to me to be irreducible. There remains a fundamental difference between human cooperation and human-machine interaction. The two may be almost indistinguishable in many contexts, but the specific qualities of each remain separate and important. I'll return to this, let's look in more detail at teacher-AI cooperation.

4. AI's Role in Empowering Educators and Learners

Recently I was in conversation with some former colleagues. We were discussing the idea (and reality) that AI can be used for academic misconduct. One university tutor spoke at length about the difficulty in detecting AI generated text, and the huge potential negative impact on learning if students can reliably "contract out" their essays to an LLM. When they had finished, another one of my former colleagues, fairly reserved by nature, quietly said "I think we're going to have to go back to giving verbal exams on student work". The rather uncharitable and unprintable reply was centred on the amount of time it would take to conduct a *viva* for each extended writing assessment in a university year. The consensus eventually emerged that just about enough time could be saved, if ChatGPT could be coaxed into marking the essays written by students (and their helpers) and that a verbal exam could be a reliable way of checking if any actual learning had taken place, certainly at least as reliable as the average essay. Education has entered an arguably long overdue period of transformation, which could ironically see technology facilitate a strengthening of student-teacher connections. AI disrupts traditional assessment methods by amplifying the voices that have long been calling for more authentic, dynamic and continuous evaluation of learning. Traditional exams often measure memorisation and highly specific communicative genres ahead of critical thinking and problem-solving skills. AI-powered assessment platforms analyse a student's responses, across a range of dimensions, but no less significantly, AI pushes teachers and leaders to reconsider their assumptions about assessment. This may be a less comfortable relationship with technology, but it will certainly be a productive one.

It is easy to optimistically imagine a scenario where students would benefit from the kind of contact with educators that was previously only the privilege of a tiny minority. NLP-driven AI will make language education more accessible. Learners with disabilities, such as dyslexia, benefit from AI tools that offer real-time text-to-speech and speech-to-text conversion. It would be irresponsible to throw out the opportunity in front of us in order to avoid engaging with the challenge of modernising assessment. I've provided a sample of relevant resources on how this challenge and others are already being initially addressed in the "Further Reading" section at the end of this article.

AI-powered virtual tutors bridge the gap between learners and educators, extending learning beyond the classroom. Learners can seek immediate clarifications and explanations for complex language concepts, breaking down barriers that might hinder progress. Whether it's unraveling the intricacies of verb conjugation or understanding the nuances of idiomatic expressions, AI can act as a companion that offers guidance on-demand. AI can recommend relevant articles, podcasts, and videos, catering to learners' passions and deepening their language proficiency in areas that resonate with them.

Through AI-generated insights, educators can gain valuable data-driven perspectives on their students' learning journeys, far beyond the utility of traditional corpora. Imagine an AI system that tracks learners' progress, identifying features such as commonly misunderstood grammar rules, usage idiosyncrasies, or challenging vocabulary. Consider an AI platform that assesses language learners' writing samples. By analysing common errors and patterns, the AI generates a personalised roadmap for improvement, suggesting exercises that directly target identified weaknesses. There's nothing to stop AI from analysing spoken language interactions, providing insights into pronunciation challenges and recommending focused practice. Language learners can engage in group discussions, practice conversational skills, and collaboratively work on assignments through AI-mediated platforms. With the concerns already mentioned in mind, these interactions can mirror, if not substitute perfectly for, real-world language use, instilling confidence and improving overall communication abilities, all while capitalising on the power of AI as a facilitator. Educators can then tailor their teaching strategies, crafting targeted lessons and exercises to address these specific areas of concern. As AI evolves, it may gain further access to real-time language data from diverse sources, including social media, news articles, and academic texts. This will enable AI to stay current and equip learners with more up-to-date language skills, preparing them more effectively for the linguistically dynamic world beyond the classroom. Researchers in diverse fields like sociolinguistics and World Englishes will have access to data and analytical insights never previously possible. We are already beginning to realise the impact of the need to interact with AI through natural language, in prompt engineering, content creation and the ability of AI LLM's to tailor their output to requirements. When access to rhetorical and logical development is limited by the maximum boundary of what the human mind can process, how much better can our species get at communicating?

If we accept for a moment the possibility of a partnership between human educators and AI technologies this could become a cornerstone of enriched language learning. I see this as not only optimising language acquisition but creating space and time for a renewed focus on the well-being of learners, and for human connection between teachers and learners to broaden and deepen. Again, perhaps optimistically, I see it as self evident that while AI remains at the level of intelligence rather than consciousness, the learning process for humans will remain necessarily fundamentally

human. We have adopted some technological idioms to describe our human experience, such as "hard wired" and "plugged in", but we are not creatures of wires and plugs, our connections are intrinsically human, mammalian, organic. As far as we are currently aware, the only thing in the universe that is capable of thinking, feeling and caring about human beings is....a human being. We can only thrive as socialised beings. We are psychologically and biologically primed to respond to one another. Nothing triggers the mirror neurons of *homo sapiens sapiens* quite like members of the same species. Despite the exciting and promising leaps in technology, that fact of our embodied consciousness remains unlikely to change soon.

That being said, AI, in the hands of educators, can engage students on a deeply personal level. Beyond classroom discussions, imagine an AI-assisted system that offers one-on-one assessment sessions. Through conversations, AI gauges a student's linguistic strengths and weaknesses, providing educators with detailed performance data. With this information, educators can create bespoke learning pathways, nurturing each student's unique linguistic journey beyond top-down programmes of study that must necessarily strike hard balances between student and institutional needs. The result is a classroom experience that optimally utilises time, focusing on individualised contact time while AI provides insights. AI may recognise linguistic patterns, but human educators identify curiosity or confusion instinctively. Student well-being requires emotional support, encouragement, and mentorship. Human educators forge emotional connections with students that go beyond academic instruction. These connections are built on understanding, empathy, and mutual respect. In this model, AI becomes an optimised teaching assistant, facilitating the student-teacher relationship. AI's future role isn't to replace human educators but to amplify their impact. With routine tasks automated, educators can focus on mentorship, one-on-one interactions, and guiding students through advanced concepts. AI handles administrative duties, freeing educators to invest more time in meaningful connections and personalised instruction. Imagine a future where educators have more time to mentor students individually, providing guidance on career paths, offering academic counseling, and fostering a strong support system. Educators, armed with AI insights, can design tailored exercises to collectively address this challenge. The result is a classroom experience that utilises time more effectively, focusing on individualised guidance while AI provides high level insights.

Will it always matter if an intervention comes from a codebase or from a human person who has chosen to care about another? Personally, I would accept lower productivity and efficiency in order to preserve moments of meaningful human connection like the ones I have experienced in my professional life. These moments have a value in themselves that I believe our technology will promote and preserve rather than undermine.

5. Natural Language Processing for Authentic Learning

The advent of AI and Natural Language Processing (NLP) has revolutionised language education by introducing more authentic, real-world interactions into the learning process. Through AI-driven chatbots and language models, learners can engage in dynamic conversations, enhancing fluency and confidence in practical language use. Language learners can use AI chatbots to engage in simulated conversations. These chatbots employ NLP algorithms to understand context, intent, and nuances, providing tailored responses that mimic authentic language interactions. For instance, a learner practicing a restaurant dialogue with an AI chatbot receives not only correct grammar and vocabulary suggestions but also contextually relevant prompts that facilitate natural conversation flow. NLP-powered AI models offer learners the opportunity to immerse themselves in authentic language use. Learners can write essays, emails, or participate in virtual discussions, receiving AI-generated feedback that evaluates grammar, coherence, and overall language proficiency. The feedback is not only comprehensive but also immediate, enabling learners to refine their skills in real time, massively expanding the access to linguistic practice and feedback.

As mentioned above, NLP goes beyond grammar, it is capable of operating on the level of context and intent. AI models can decipher the meaning behind idiomatic expressions, cultural references, and may even be trained to pick up on emotional cues. It will not be long until AI models will be used to engage in training and even therapeutic settings where emotional communication is the focus.

6. Identifying Learning Trends and Challenges

AI's data analysis ability will reveal overarching trends and challenges within a class, cohort or population. This will change the teacher training learning curve and give educators at all stages of their career access to powerful data insights. It's easy to imagine the impact of AI quickly identifying if numerous students consistently misinterpret a particular grammar rule, allowing educators to address it comprehensively during class discussions. What is more difficult to conceptualise is the impact of an AI driven awareness of learner Englishes and other additional language learning on a global scale. This proactive approach transforms challenges into learning opportunities. Identifying trends also helps educators to determine whether and to what extent specific teaching methods are resonating with the majority of students or if adjustments are needed.

Educators will refine their teaching strategies by utilising AI-generated insights. Learner profiles on entry and exit to courses of study will be much more finely detailed, allowing the analysis of needs and the development of tasks and study plans at a demonstrably more effective level. Data-driven insights enable educators

to quantify progress longitudinally. By analysing metrics such as test scores, participation rates, and specific task experience for learners, educators can evaluate the efficacy of their teaching strategies. This quantitative feedback guides continuous improvement, enhancing the overall learning environment. Work is already being done on integrating AI tools into the TPACK framework for language learning (see "Further Reading"), and this type of instructional design will continue to grow in prominence.

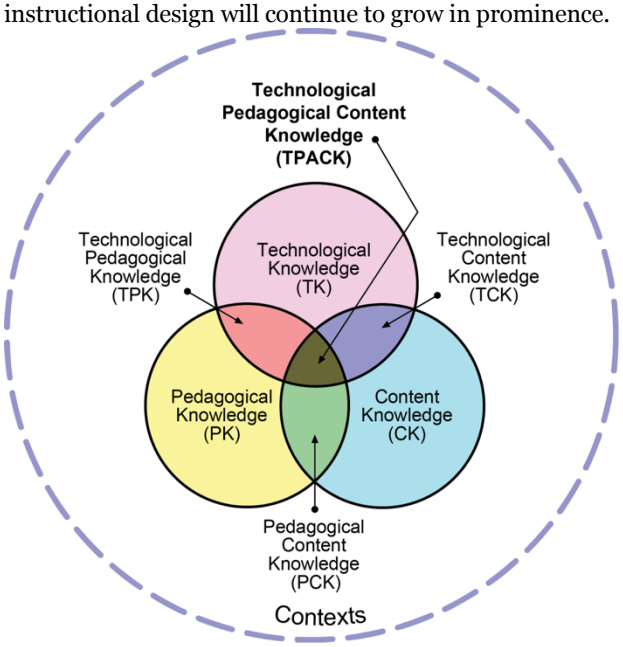

Figure 2. TPACK Framework.

Data-driven insights enable educators to quantify progress over time. By analysing metrics such as test scores, participation rates, and completion rates, educators gauge the efficacy of their teaching strategies. This quantitative feedback will enable and guide continuous improvement, enhancing the overall learning experience without increasing the demands on teacher time. Going further, AI may have a disproportionally positive impact on students who are struggling for a variety of reasons. AI-generated data may provide early intervention opportunities. If data reveals that a student's performance is declining or deviating from their individual norm, educators can intervene promptly, offering additional support or customised tasks. This proactive approach prevents learning gaps from widening, and outside factors from impinging on learning. This will elevate differentiation and support student goals.

7. Future Possibilities

As AI continues to evolve, the future of language education is to some degree uncertain. More positively, we can conceptualise this as a paradigm shift in what can be achieved. Immersive language simulations, advanced cultural insights, and even more personalised learning experiences are on the way. AI's role in education will be one of enhancement rather than replacement, augmenting human educators and learners alike.

As previously noted, the process will not be comfortable. Growth and change is by definition destabilising. AI is already putting selection pressure on many fields of human work. The integration of AI technology into education doesn't revolve around shareholder value. Instead it is propelling educational institutions toward disruption and evolution. AI's impact on education starts by acknowledging the sector's existing shortcomings. Traditional education systems often struggle with rigid curricula, standardised assessments, and limited personalisation. These inadequacies hinder the potential of diverse learners and fail to meet the needs of today's stakeholders. By identifying current inadequacies, AI catalyses improvements across learning methodologies, assessment strategies, student experiences, and teacher training. As teachers, reflection is fundamental, and the purest analogy for AI may be that of a mirror for our capabilities and inadequacies. If we don't like what we see, can we can do better?

AI's role in education will not be static or linear in progression. As students engage with AI-powered platforms, data accumulates, revealing patterns of learning behavior. Educators and institutions can use this data to iteratively enhance curricula, teaching materials, and learning experiences. This continuous improvement loop will likely develop into a powerful progressive force that will encourage relevant and impactful learning, but it will not be predictable.

In the crossover between education and linguistics, much is made of the ideas of collaboration, autonomy and shared discovery. AI amplifies collaborative learning by facilitating genuine partnership between students and educators. Through AI-mediated platforms, students and educators engage in co-learning, where both parties contribute knowledge and insights. For instance, an AI-assisted discussion board could enable educators to pose challenging questions and guide students in collectively exploring complex topics and forming perspectives. This collaborative dynamic nurtures critical thinking, as the group moves through an uncertain experience together, reflecting as they go. It may be that with the advent of AI, a more collaborative and authentic learning experience may be possible, but this may demand the relinquishing of traditional norms of control in order to advance higher order objectives, in a classroom shared with a non-human intelligence. While on the subject of elevating the student experience, it is worth noting the potential of AI to significantly enhance the quality and speed of delivery of student projects, particularly multimedia portfolios and projects. AI-driven tools offer real-time feedback on elements such as visual design, grammar, and content coherence. A student creating a multimedia presentation might receive AI-generated suggestions to improve slide layouts, enhance visuals, and refine language, for example. This will encourage student projects to aim at a professional standard, effectively communicate ideas, and exercise transferable skills. Of course, this will require teachers to reimagine their role, familiarise themselves, experiment, and be open to challenges.

In summary, the positive pressure that AI puts on universities and educational institutions is multifaceted. It prompts institutions to reevaluate their methodologies, embrace innovation, and prioritise the holistic development of students. AI-driven insights empower

educators to make data-informed decisions, leading to a more tailored and effective learning journey for each student. Ultimately, AI's role isn't to replace educators, but to augment their expertise, creating an educational ecosystem that equips learners with the skills they need to thrive in a changing world. I've attempted to offer a survey of some of the opportunities that my own experience experimenting with AI in the classroom has suggested.

8. The Human Experience of Education

On a philosophical level, for now, the human experience in education goes beyond AI's capabilities. The intangible aspects of human consciousness, the ability to form new knowledge creatively, and the depth of emotional understanding are integral to learning. These qualities defy algorithmic replication and form the basis of education's multidimensional nature and origin. The human mind's capacity for creativity, connection and innovation is a cornerstone of education. While AI excels at data analysis and pattern recognition, it lacks the specific phenomenological qualities and spontaneous creativity that humans bring to learning. It lacks this because AI does not and cannot know what it is to be human. Consider a classroom discussion where students explore a novel interpretation of a text. Human educators encourage diverse perspectives, nurturing the growth of original ideas that contribute to the depth of understanding, and this discussion is based implicitly in a real world experience. This makes a qualitative difference, and it is this qualitative difference that gives me the confidence that the relationship between humans and AI will be one of partnership. AI can have my marking, it can help me with my planning, but it can't yet have my connection with my students. AI is chasing at our heels, like a new colleague with new ideas and abilities that challenge us. The question remains, are teachers ready for this challenge?

Seán Timon has been teaching English since 2007 in Nepal, Romania, South Korea & the UK. He is passionate about teaching with impact and has led successful projects of change in a wide variety of educational contexts. In addition to teaching at primary, secondary and university level, he is currently reading Applied Linguistics at Kellogg College, University of Oxford. His research interests include language acquisition, sociolinguistics and educational technology.
Email: sean.timon@education.ox.ac.uk

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Review OPEN ACCESS

Age as a factor determining effectiveness of L2 acquisition

Katarzyna Li

Department of Education, University of Oxford, Oxford, United Kingdom

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Abstract

A common belief is that the earlier we begin learning a language, the better chance we have at mastering it. Some push this belief further, suggesting that after one reaches a certain critical age the odds of succeeding at attaining high proficiency in L2 are dropping dramatically. However, research remains inconclusive regarding not only at what age these cut off points should be, but also whether they are indeed a fact. Nevertheless, learners, teachers and policy makers tend to repeat after Krashen et al. (1979) that "adults and older children in general initially acquire the second language faster than young children (older-is-better for rate of acquisition), but child second language acquirers will usually be superior in terms of ultimate attainment (younger-is-better in the long run)" (p, 574). This article examines historical and recent empirical evidence gathered in relation to the views that earlier onset of L2 acquisition impacts the ultimate attainment of the learner, and explores why older learners are seen as those learning faster. It also points out an oversight regarding the comparison between younger and older learners without considering the setting in which the language acquisition takes place. Finally, pedagogical implications of juxtaposing the empirical evidence with the views often cemented in the mentality of students, teachers and policy makers are presented.

Keywords age of onset, rate of acquisition, ultimate attainment, naturalistic L2 learning, instructed L2 learning

1. Introduction

The relationship between age and successful second language (L2) acquisition has been a subject of debate for years (Singleton & Pfenninger, 2022). Krashen et al. (1979) extended the view stating that "the earlier, the better" by suggesting that while older learners will acquire the L2 knowledge faster, early age of onset[1] (AO) is more likely to lead to superior ultimate attainment (UA). Indeed, policymakers tend to equate early (AO) with successful L2 acquisition (European Commission, 2017). However, researchers point out that this relationship is not linear (van der Slik et al., 2022). It can also be moderated by multiple affective and environmental factors (Pfenninger, 2017), individual aptitude (DeKeyser, 2000), and even the mode of acquisition (Pfenninger, 2020).

2. Context

Based on the notion of imprinting (Lorenz, 1958), Lenneberg (1967) proposed that once the AO for language learning passed a critical period (CP), one's ability to achieve native-like UA sets off sharply and irreversibly, regardless of other mediating factors (ibid.). Data from observation of input-deprived children confirm that in L1 learning AO is indeed negatively correlated with UA (Hyltenstam & Abrahamsson, 2003). The cut-off points for discontinuity of L1 learning ability, initially associated with puberty (Curtiss, 1977), were observed to differ depending on the element of language, remaining at puberty for vocabulary acquisition, but varying between four and eight years old for the acquisition of syntax-related aspects, and six to twelve months to prevent impairment of phonetic perception and controls for verbal memory (Ruben, 1997).

Due to historical research, it is generally believed that in L2 education older learners are at disadvantage due to brain lateralization (Lenneberg, 1967) and loss of brain plasticity (Penfield & Roberts, 1959, p. 236). However, results from modern research challenge both views (Gutchess, 2014; Nenert et al., 2017). Aside from the debate regarding the shape of the attainment curve as a function of age (van der Slik et al., 2022) and potential cut-off AO (Abrahamsson et al., 2018), researchers disagree whether achieving native-like UA is at all possible (Dąbrowska, 2012; Hyltenstam & Abrahamsson, 2000), or even desirable (deBot, 2014). Moreover, while some results of studies indicate superior UA of learners who began learning L2 within CP, especially in areas of grammar (Johnson, 1992; Johnson & Newport, 1989; Patkowski, 1980) and pronunciation (Flege, 1999; Flege et al., 2010; Long, 2005; Oyama, 1976), other studies suggest that not only can mature learners achieve higher

[1] Age, at which language acquisition begins (Singleton & Ryan, 2004).

proficiency levels, they can also do it in a much shorter time (Muñoz, 2006; Oller & Nagato, 1974). Older learners' ability to acquire L2 to a high level could be mediated by their verbal analytical aptitude (Bley-Vroman, 1988), working memory (DeKeyser, 2018), and above everything with the type of instruction, while young children rely more on implicit learning (Bley-Vroman, 1988) and phonological short-term memory (DeKeyser, 2018). Finally, a decline in ability connected to biological maturation (Eubank & Gregg, 1999) might concern only certain aspects of language learning (Singleton & Ryan, 2004), and happen in a gradual way (Lamendella, 1977).

3. Empirical Evidence

In this section, results of empirical studies referring to Krashen et al.'s (1979) statement regarding the relationship between AO, UA, and rate of acquisition (RAq) are presented and discussed. Further details regarding the populations and methodologies of the mentioned studies are available in Appendix 1 (for naturalistic setting) and Appendix 2 (for instructed setting).

3.1. Younger is Better

The tendency to confirm that "younger is better" seems to be prevalent mainly within naturalistic studies, focusing on observing immersed learners, either immigrants or students following a school program using L2 medium of instruction. In these studies, participants acquire their L2 knowledge mainly through implicit learning. Immigrant studies tend to show that earlier AO can be associated with higher success in attaining native-like pronunciation (Piske et al., 2002) and grammar (Hyltenstam, 1992; Patkowski, 1980), higher confidence regarding own skills (Dewaele, 2010), less language anxiety (Johnstone, 2009), and lead to an increased probability of resorting to L2 during communication with peers (Hammer & Dewaele, 2015; Jia & Aaronson, 2003).

More recently, Qureshi (2021) observed similar, significant effects of AO on grammaticality judgement test (GJT) scores for Arabic students exposed to English medium instruction (EMI). In the study, the students who started EMI in primary school outperformed students who started it only in tertiary education. However, these effects did not hold for the error-correcting task. In other words, although the early starters knew "something" was wrong, they were not able to locate and correct the erroneous phrases. Concomitantly, Bolibaugh and Foster (2021) confirmed a strong negative correlation between AO and participants' GJT scores of Polish-English immigrants. While recognition of grammatical sentences was unaffected by AO, it was negatively correlated with the rate of correct rejections of ungrammatical sentences. These grammaticality effects were mitigated for participants with higher scores on phonological short-term memory and affected by participants' ability for implicit statistical learning[2] (ISL).

Strong grammaticality effects in the studies might suggest that the amount and quality of the absorbed input can be stronger predictors of successful L2 acquisition, than AO. Thanks to longer exposure, early starters were likely to benefit more from ISL, hence had a bigger chance to encounter one of the constructions in a correct form. However, recognising a structure as incorrect, rather than not-yet-met could require metalinguistic knowledge which would enable the participants to actively operate on grammar. Moreover, GJT alone is not reliable enough to measure patricipants' knowledge of grammar (Tabatabaei & Dehghani, 2012), and the way GJT is implemented can impact the type of knowledge it measures (Godfroid et al., 2015). Additionally, inconsistencies regarding ways to operationalise AO[3] and UA, input quantity and quality, participants' socio-economic status, and their education levels, weaken presented evidence that lower AO correlates positively with successful L2 acquisition. Moreover, small sample sizes in some of these studies do not warrant using inferential statistics (Jung, 2020) which further debilitates the generalizability of the findings. Finally, relying on ANOVA instead of mixed models reduces the participants to a single cluster, without considering their family, class, teacher, or school characteristics (van der Slik et al., 2022).

3.2. Older is Better (and Faster)

Krashen et al. (1979) hypothesized that students commencing L2 acquisition later (also referred to as late starters or older learners) will learn faster than early starters, but they are unlikely to achieve as high UA. Nevertheless, research focusing on instructed L2 acquisition tends to provide evidence for superior attainment of older learners, especially regarding the rate of acquisition. Instructed studies refer to studies based on intentional L2 learning conducted in a school setting, within a limited number of instruction hours per week.

In the project examining English acquisition by Spanish-Basque bilinguals, Cenoz (2002) observed that the late group consistently obtained higher scores that the early starters in all aspects except for pronunciation (in which younger starters significantly outperformed the older ones), and listening (where the difference existed but was only marginally significant). Muñoz (2006) observed a similar trend in her big-scale, longitudinal Barcelona Age Factor project, in which later starters scored significantly higher on nearly all tests[4]. Pfenninger (2017) found AO effects malleable, in comparison to other macro-contextual and micro-contextual factors, which can mediate the AO–UA relationship. Moreover, Jaekel et al. (2017), in another longitudinal, large sample study focusing on receptive skills of two cohorts of German primary school learners differing in AO, show that despite the initial advantage of the younger group, within 4 years late starters not only caught up but also outperformed their peers in terms of receptive skills. In support of these

[2] Ability to extrapolate from stochastic data based on encountered sequential patterns (Conway et al., 2010).

[3] As age of arrival (Patkowski, 1980; Piske et al., 2002), age of exposure (Qureshi, 2021), age of beginning of instruction (Hammer & Dewaele, 2015) or a construct blurring the two definitions (Hyltenstam, 1992).

[4] On one comprehension test the advantage of older learners though present, was not significant.

findings, Pfenninger & Singleton (2019) demonstrated that the initial strength of AO as a predictor of L2 acquisition success[5] disappeared within six months of secondary L2 instruction in terms of productive skills: written and oral complexity, accuracy, and fluency; differences regarding other skills faded away by the end of the mandatory secondary school time[6]. A slight initial advantage of early starters has also been observed by Jaekel et al. (2022), who compared primary students' receptive skills after 2 and 4 years of L2 exposure. Baumert et al. (2020) in a separate large sample, longitudinal study examining the progress of students from over 1000 German federal state schools shows that late starters can reach parity in terms of receptive skills within five years. Interestingly, in the content and language integrated learning (CLIL) context, students' progress improves most significantly after they turn 10, however differences in AO beyond two years seem to negatively affect the UA in terms of written and oral fluency, accuracy, and oral lexical richness, but not on the other measures (Pfenninger, 2020).

Given highly representative large samples, longitudinal, systematic approach, consistent definitions of AO, and clear definitions of UA, the studies presented above provide strong support for Krashen et al., 1979 statement regarding superior rate of acquisition of late starters, while concomitantly disproving the hypothesis that lower AO can predict higher UA (in instructed setting). Presented evidence is in line with recently built L2 acquisition models of van der Slik et al. (2022), who suggest that frequently quoted discontinuities in L2 learning ability caused by maturational constraints may instead be linked to societal factors, such as leaving secondary education, associated with fewer opportunities to learn L2.

4. Pedagogical Implications

Context of L2 acquisition can impact whether the knowledge is likely to be internalized. Research indicates that although early immersion might give students an advantage regarding pronunciation, recognition of correct morphosyntax and a better attitude towards using the language, earlier introduction of L2 to the curriculum did not guarantee students' higher UA. One of the reasons for that might be a mismatch between widely offered input-limited learning modes and student needs.

While older students' cognitive maturity makes them better fitted for classroom instruction and formal testing (Singleton & Ryan, 2004), younger children (under the age of 10) might find more immersive, oracy-focused methods more beneficial (Pfenninger, 2020). Hence, one of the challenges is to ensure provision adequate for the age, to sustain student interest (Waninge, 2014). Another prominent factor in designing a successful L2 teaching program for early starters is ensuring the amount of input adequate for the learning mode (DeKeyser, 2018), to help students achieve a combination of systematicity and automaticity possible thanks to ISL (Ellis, 2004). For the younger learners, it will mean significantly increasing the number of hours of exposure. Furthermore, it is important to create an environment supporting the use of L2 during the lesson (Piske, 2017), and within students' own inner circles, where L2 is used in relation to L1 (Moyer, 2014). Thus, reshaping the program to resemble CLIL seems the most promising solution to increase the L2 UA through continuous speech (Campfield & Murphy, 2014), while maintaining current provision times for other subjects, and without disadvantaging students' L1 development.

In the case of adolescent learners, it is of great importance to ensure that the transition between implicit learning and rule-based learning does not affect learning continuity (Tuyet, 2020), which could impact students' motivation negatively. To achieve that, teachers need to carefully balance the difficulty level not to overwhelm the students with unrealistic expectations, while maintaining the right level of challenge. Finally, learners of all ages need to be reminded that their AO does not predestine their UA, and challenges stemming from maturation, such as auditory acuity decline, can be overcome with appropriately adapted instruction.

5. Conclusions

The impact of age on learning processes has been debated for decades. Reasons for this controversy can be found in the way age-related research is designed. While studies concerning age in instructed settings are predominantly consistent in the way they operationalise key concepts such as AO and UA, immigrant-based research is full of conceptual misunderstandings. Thus, while the results regarding the lack of impact on AO on UA in instructed setting can be considered robust thanks to large samples, longitudinal approach, and treating age as a continuous, multifaceted variable, more research including better sampling and instrumentation is needed to strengthen the generalizability of the results regarding learning in immersed context.

In this article, empirical evidence speaking against Krashen et al.'s (1979) hypothesis that earlier AO shall be associated with higher UA was presented. Simultaneously, however, presented research lends support to the statement that older learners acquire foreign languages at a higher rate. To learn effectively, students with low AO appear to need an immersive, input-rich setting, and instruction focused on building links between L1 and L2 through activities promoting communication in L2. In the case of students starting learning a foreign language later, using more implicit, rule-based instruction full of examples and opportunities to both infer rules from context and test the hypotheses in practice seems most beneficial. Furthermore, informing the students that empirical studies disprove the "common wisdom" that "the younger the better" might be important to prevent the

5 Initially, AO was found to be a predictor of 60% of the tested skills (receptive vocabulary, written lexical richness, written fluency, oral lexical rich-ness, oral accuracy, and written GJT)

6 For all the examined groups but the simultaneous bilinguals, who might be processing the L2 input differently on the account of biliteracy-driven superior working memory and better processing control (Bialystok, 2007).

impact of age-related defeatism on motivation. The latter is particularly important in the case of L2 geragogy[7]. These observations should be reflected in the way educational policies and foreign language curricula are designed, to ensure that students receive the provision which best suits their AO.

Katarzyna Li (née Jasinska-Belfort) is a polyglot and a language teacher. She has been teaching English, German and French as first and foreign languages in various academic settings for over 10 years in Japan, Poland, Brazil, Hong Kong, UK and Switzerland. She graduated Computer Science at the University of Southern Denmark, obtained PGCE in Modern Foreign Languages from University of Manchester, and is currently completing her MSc in Applied Linguistics at the University of Oxford. Her research interests include neurology of L2 acquisition, child multilingualism, vocabulary acquisition, factors that affect one's ability to attain high proficiency in L2, and statistical data analysis in context of education-related research.
Email: katarzyna.jasinskabelfort@education.ox.ac.uk

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX 1: Comparison of studies conducted in naturalistic environment

The table also briefly summarises the methods used to measure students' UA, and ways in which authors operationalise the AO.

Author	N	Brief description	Length of stay	Study focus	UA measurement method	AO definition
Piske et al., (2002)	64	Native Italian subjects living in Canada using English as L2 daily; Mean age at testing = 35, mean age overall = 48 (no standard deviations available), pure tone hearing	Minimum 18 years	Production of vowels	One at a time, repeating English and Italian words based on the recorded stimuli	Age of arrival
Patkowski (1980)	67	Mixed-nationality, highly educated, middle class, various ages	Minimum 5 years	Syntax command	Syntactic ratings of 5-minute long samples of recorded oral interviews, assigned by two judges	Age of arrival
Hyltenstam (1992)	24	Adolescent native-like active bilinguals of Swedish, 12 for whom L1 was Finnish, 12 for whom it was Spanish	Not controlled	Accentedness, lexical and grammatical accuracy	Retelling of four prepared texts (two read and two heard) plus a composition about a movie shown beforehand; no time limit; accuracy judged by the teacher	Not specified, comments implying both age of arrival and age of beginning of L2 instruction can be found in the paper
Jia and Aaronson, (2003)	10	Native Chinese immigrant children who were between 5 and 16 when they immigrated; 7 of them spoke only Mandarin, and 3 spoke Mandarin and another Chinese dialect; university-educated, varied income levels	Not controlled	Use of grammar The impact of L2 development on L1 proficiency	□ GJT □ L1 to L2 oral translation task	Age of arrival mixed with age of commencing education in a US school

Hammer and Dewaele (2015)	149	Polish-English immigrants with a university degree, mean age 31, (SD= 4.7), majority were female (86 to 14 ratio); sequential bilinguals	Not controlled	Impact of AO on acculturation and self-perceived L2 proficiency level	Participants' own perception of native-like capability	Age of exposure to instruction
Bolibaugh and Foster (2021)	35	Polish-English immersed bilinguals residing in West London, whose AO ranged ranged between 1 and 35 years; 18 of the participants were pre-instructed (mean 2.66 years, SD=3.92)	Not controlled	Grammatical accuracy as a function of AO, phonological short-term memory and implicit statistical learning	GJT, a 40-minute-long listening task; the recording consisted of 5 practice items and 110 test sentences; participants' answers were assessed against answers of 30 adult monolingual native English speakers.	Age of arrival
Qureshi (2021)	84	University students in UAE learning English; 61 of them attended EMI instruction from primary school, while 23 started learning English at tertiary level; participants' proficiency judged based on IELTS score (average 6-band), 2 participants spoke both English and Arabic at home, 11 participants attended English language centre.	Not controlled, "early" learners were in fact EMI learners, and "late" learners were students whose immersion started when they entered university	Grammatical accuracy in terms of AO and (implicitly) type of instruction in early age	Paper-based GJT, 114 items on 12 rules and an editing task – text containing 24 errors to be corrected; reliability coefficient KR-20 = 0.89	Age of exposure to EMI

Table 1: Comparison of studies conducted in naturalistic environment

APPENDIX 2: Comparison of studies in conducted in instructed environment

This table includes comparison of empirical studies conducted in minimal-input and immersed instructed settings.

Author	N	Brief description	Length of instruction	UA measurement method	AO definition
Cenoz (2002)	564	Basque-Spanish bilinguals learning English as L2 for 564 hours (six years). Early starters were tested at 13, late starters at 16		Comprehensive test including: □ Cloze test, □ Written composition □ Oral narration	Early starters = 8 Late starters = 11 years old
Muñoz (2006) BAF project	1928	Catalan-Spanish bilinguals from state schools in Barcelona; low-middle class, middle class and professionals; Some subjects had more exposure due to extracurricular classes	200 hours (first test) 416 hours (second test) 726 hours (third test)	Extensive test battery including: □ Dictation (in English, Catalan, and Spanish) □ Cloze (in English, Catalan, and Spanish) □ Listening comprehension □ Grammar □ Written composition □ Oral narrative □ Oral interview □ Phonetic imitation □ Phonetic discrimination □ Role-play	Beginning of instruction; very early = 2-6 early starters = 8 late starters = 11 very late = 14 adult = 18+
Jaekel et al. (2017)	5130	German primary school students from 31 grammar schools learning English as L2, who were tested in Year 5 and in Year 7	Early starters = 3.5 years / 5.5 years (240/549 hours) Late starters = 2 years / 4 years (140 / 444 hours)	Receptive language skills test (listening and reading); □ Listening: picture recognition and sentence completion in German □ Reading: multiple choice and open questions	Beginning of instruction; early starters = 6-7 years (Year 1); late starters= 8-9 years (Year 3)
Pfenninger (2017)	200	Swiss students learning English, tested at 13 and at 18	Early starters = 11 years Late starters = 5 years	□ Listening comprehension task, □ Argumentative and narrative essays □ GJT □ Vocabulary size test □ Productive vocabulary size test □ Oral recount and spot-the-difference task	Beginning of instruction; early starters = Grade 1 (German) Grade 3 (English) Grade 5 (French) late starters = 13 years (English)

Pfenninger & Singleton (2019)	636	Swiss secondary students aged 13-14 years at first collection and 18-19 at second collection learning English as L2, L3, or L4	Early starters = 5.5 year Late starters = 6 months	CEFR B1-B2 test including: - Listening task - Receptive vocabulary test - Productive vocabulary test - Written lexical richness, syntactic complexity, fluency, and accuracy - Oral lexical richness, syntactic complexity, fluency, and accuracy - GJT	Beginning of instruction; early starters = 8 years; late starters = 13 years

Baumert et al. (2020)	19857	German students from different types of federal schools learning English as L2; tested at 15-16 (Year 9)	Early starters = 638 hours
			
			Mid starters = 561 hours
			
			Late starters = 471 hours
				- Reading and listening comprehension tests;
				- Levels of difficulty of items ranging between CEFR A1 to C1
					Beginning of instruction;
					early starters = 6-7 years;
					
					mid starters = 8-9 years;
					
					late starters = 10 years

Pfenninger (2020)	91	4 groups of Swiss children form a private (pre) primary school receiving 50-50 German-English CLIL	Early starters = 8 years Mid starters = 6 years Late starters = 4 years	- Students' writing complexity, accuracy and fluency (holistic); - Analysis of repeated features in oral and written tasks (a recount, a narrative essay and an argumentative essay)	Beginning of instruction; early starters = 5 mid starters = 7 late starters = 9
Jaekel et al. (2022)	7289	German Primary students learning English as L2, tested in Grade 5 (10 years)	Early starters = 245 hours Late starters = 140 hours	Paper-based reading and listening multiple-choice tests targetting picture recognition and sentence completion	Beginning of instruction; early starters = 7-8 years (Grade 1) late starters = 9-10 years (Grade 3)

Table 2: Comparison of studies conducted in instructed setting

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ORIGINAL RESEARCH OPEN ACCESS

A study on the optimization of English writing teaching system in medical colleges and universities based on the perspective of curriculum ideology and politics

Yu Pan

Wenzhou Medical University, Wenzhou, Zhejiang Province, China

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Abstract

By adopting a theoretical framework based on constructivism and Content and Language Integrated Learning (CLIL), this study uses case study and action research methods to explore how to enhance medical students' language skills, humanistic literacy, and research awareness under the perspective of curriculum ideology and politics. Observations and in-depth interviews revealed teachers' and students' views on English writing teaching, while action research explored and tested strategies for teaching reform. The results indicated that integrating the cultivation of language skills, humanistic literacy, and research awareness into the actual teaching process, along with providing ample practical opportunities and specific guidance, are key to improving medical students' abilities. Continuous evaluation and adjustment are required in teaching reform to ensure its effectiveness and adaptability. This study provides empirical evidence for understanding how to optimize teaching activities under the perspective of ideological and political education in the curriculum to enhance the language skills, humanistic literacy, and research awareness of medical students, and provides guidance for future teaching reforms.

Keywords ideological and political education of curriculum, medical colleges, English writing, teaching system, action research

1. Introduction

Ideological and political education of curriculum is a key developmental direction in higher education in recent years. The Ministry of Education of China (2017) stressed the importance of undergraduate education reform in the *Opinions on Deepening the Reform of Undergraduate Education and Teaching and Improving the Quality of Talent Training*, and proposed ideological and political education of curriculum as an important means of educational and teaching reform. Subsequently, the Ministry of Education (2020) detailed the specific requirements of ideological and political education of curriculum in the *Guiding Opinions on Promoting Ideological and Political Education in University Courses,* which included integrating ideological and political education content into professional course teaching to improve students' ideological and political literacy. Moreover, the Ministry of Education (2020) proposed related requirements for strengthening and improving the construction of ideological and political theory courses in universities in the new era in the *Notice on Strengthening and Improving the Construction of Ideological and Political Theory Courses in Universities in the New Era*, further emphasizing the important position of ideological and political education in higher education. All these documents provide important policy basis for understanding and implementing education on curriculum ideology and politics.

With the issuance of these policies, the important tasks and directions of higher education in the new era have been clarified, namely, deepening teaching reform and improving the quality of talent training comprehensively. Medical education, as an important part of higher education, faces notable challenges in teaching reform. Particularly in medical English writing, it requires innovative teaching methods and strategies to enhance students' language skills, humanistic literacy, and research awareness. In this process, the theories and practical methods of ideological and political education of curriculum can provide new ideas and strategies for the reform of medical English teaching. For example, by integrating ideological and political education content into English courses, it can improve students' ideological and political literacy, language skills, and humanistic literacy. Therefore, exploring and optimizing the English teaching path of medical colleges, and integrating the concepts of curriculum ideology and politics, and language teaching theories, such as constructivism and Content and Language Integrated Learning (CLIL), is an important and meaningful research task.

2. Theoretical Framework and Literature Review

2.1. Theoretical Framework

The theoretical framework of this study is based on constructivism and Content and Language Integrated Learning (CLIL). Constructivism is a theory about learning, which emphasizes that learning is constructed through the interaction between individuals and their environment, rather than passively receiving external information (Piaget, 1954; Vygotsky, 1978). From this perspective, learning is seen as a process where students construct knowledge through interaction with the environment. This understanding provides complex but effective strategies for teaching design and provides teachers with student-centered, participatory, and practical teaching methods. In the English teaching of medical colleges, constructivism can help teachers design student-centered, participatory, and practical teaching activities, and encourage students to actively participate in the learning process, to understand and master knowledge through practice and exploration. Studies conducted by Prince, et al., (2005), Savery (2006) and Schmidt, et al., (2011) discussed how problem-based learning, an educational method underpinned by constructivist principles, encourages student participation and practical application of knowledge in problem-solving.

Content and Language Integrated Learning (CLIL) is a method of studying subjects in a foreign language environment, which emphasizes the simultaneous improvement of students' subject knowledge and language skills (Coyle, Hood, & Marsh, 2010). CLIL advocates combining language learning with subject content learning to achieve dual goals of language and content. In the English teaching at medical colleges, the CLIL method can help students improve their English language skills while learning medical professional knowledge (Dalton-Puffer, 2007). This method allows students to use English in real contexts, improving their language practice ability, and also contributes to their professional learning (Perez-Canado, 2012).

Both theories emphasize the importance of student-centered teaching strategies and practical learning, which is in line with the goal of English teaching in medical colleges to improve students' language skills, humanistic literacy, and research awareness. By integrating the two theories, teachers can design and implement teaching activities more effectively, enhancing the effectiveness of teaching.

2.2. Literature Review

Regarding the application of Content and Language Integrated Learning (CLIL) in medical English teaching, although the current research literature is sparse, its successful practices in other academic fields provide potential theoretical and practical foundations for this endeavor (Morton, 2013; Nikula, Dalton-Puffer, & Llinares, 2013; Pérez-Cañado, 2012). The CLIL method encourages subject learning in a foreign language environment, emphasizing the simultaneous improvement of students' subject knowledge and language skills, which could have a significant impact on medical English teaching (Coyle, Hood, & Marsh, 2010).

It is worth noting that the application of CLIL needs to take into consideration the specific context of the teaching environment. As pointed out by Dalton-Puffer (2007), discourse in CLIL classrooms includes the communicative strategies of teachers and students, as well as the challenges of using a second language in communication. Therefore, any attempt to apply the CLIL method to medical English teaching needs to fully take into account the characteristics of the teaching environment and the needs of the students. However, so far, research on how to specifically apply the CLIL method to medical English teaching is still lacking. Although the study of Llinares and Dafouz (2020) offers CLIL practices in higher education, the specific requirements of medical college English teaching, such as the precision of medical terms possibly involved in teaching and the complexity of clinical contexts, call for more specific research and discussion.

In a series of studies, the theory and practice of curriculum ideology and politics occupy a significant position in educational research, revealing how ideological and political education is integrated into the teaching process, and emphasizing the important role of teachers in guiding students to understand social, political, and ethical issues (Li & Wang, 2021; Bai & Feng, 2021). Although these studies provide important insights for understanding ideological and political education of curriculum, how to specifically integrate these concepts into medical college English teaching still remains a research gap. Integrating humanities into medical education can enhance the humanistic literacy of medical students (Shapiro, Morrison, & Boker, 2004; Ousager & Johannessen, 2016). However, how to effectively integrate humanities into medical college English teaching is still a question that has not been thoroughly researched. As for the literature on research awareness, problem-oriented teaching methods can effectively enhance the research awareness of medical students (Khan, Taqui, Khawaja, & Fatmi, 2007; Healey, Flint & Harrington, 2016). However, how to implement problem-oriented teaching methods to enhance students' research awareness is still a research question that needs further exploration.

The aim of this study is to explore how to integrate constructivism and the CLIL theoretical framework into medical English writing teaching in order to achieve the teaching goal of enhancing students' language skills, humanistic literacy, and research awareness.

3. The Research

3.1. Research Questions

1. What are the perceptions, challenges, and confusions of teachers regarding the integration of language skills, humanistic literacy, and research awareness in medical students English writing teaching, which may reflect in student feedback and satisfaction?
2. How do variations in teaching methods and cognition of integrating writing skills with language skills among different teachers influence student

satisfaction and learning outcomes in English writing instruction for medical students?

3. What impact does curriculum ideology and politics teaching reform intervention have on student improvements in language ability, humanistic literacy and research awareness, and overall satisfaction in English writing instruction for medical students?

3.2. Research Methods

This study employs case study methods based on course observation and in-depth interviews, as well as action research methods (Kemmis & McTaggart, 2005). Direct observation of the course implementation process, questionnaire survey to students and in-depth interviews with teachers and students to gather their views and suggestions on English writing teaching, and the implementation of action research to explore and test strategies for teaching reform were conducted.

3.2.1. Course Observation

Participants and Implementation. In this semester-long course observation, the main subjects are three experienced English teachers from the School of Foreign Languages, and the 159 medical students they teach, both from a university located in Southeast of China. The first teacher is Ms. Li, who has 20 years of teaching experience and an educational background that includes a Ph.D. in English Linguistics. The second teacher is Mr. Zhang, an associate professor with 15 years of teaching experience and a master's degree in Applied Linguistics. The third teacher is Mrs. Wang, a lecturer with 10 years of teaching experience and a master's degree in English Education. The students taught by the three teachers are mainly second-year undergraduates from the medical school, with majors including Clinical Medicine, Medical Imaging, and Nursing.

The author conducts one classroom observation per class per week, each lasting 80 minutes, covering 2 class hours, for a total of 12 weeks. Therefore, the total duration of classroom observation is 2880 minutes. During the process, the author records the teacher's teaching methods and the students' reactions without any disturbances.

When recording teaching methods, the author mainly focuses on the following aspects: (1) how the teacher guides students to understand and use language, including vocabulary, grammar, and sentence structures; (2) how the teacher designs and organizes writing activities, including task types, teamwork, and feedback mechanisms; (3) how the teacher introduces and discusses professional and humanistic content in medicine in order to cultivate students' research awareness. When recording students' reactions, the author mainly focuses on the following dimensions: (1) student engagement, including whether they actively participate in classroom activities and discussions; (2) learning gains, including whether students' language skills, humanistic literacy, and research awareness have improved; (3) feedback on teaching methods, including whether they are satisfied with the teacher's teaching methods, and their suggestions for course improvement.

Results. The observation results show that although all three teachers pay great attention to the teaching of writing skills, they still have certain confusion and challenges on how to combine writing skills with language skills, humanistic literacy, and research awareness. For example, when teaching language knowledge, the introduction of humanistic content and research methods is often overlooked; when organizing writing activities, the emphasis is often on the accuracy of language, neglecting students' thinking and exploration. Student feedback also reflects these issues, as they expressed a desire for more opportunities to learn and use professional and humanistic knowledge in medicine, as well as participate in research activities in writing. These results provide me with valuable insights, namely, in English writing teaching, a better integration of the teaching of language skills, humanistic literacy, and research awareness to more comprehensively will potentially improve the overall quality of medical students.

3.2.2. Questionnaire

Setting and Participants. After the completion of classroom observation, the author designed a questionnaire titled *Evaluations of Course Learning and Self-Achievement* (see Appendix 1) and interviews. The questionnaire collected the 159 students' views on English writing courses, focusing on the following variable dimensions, with responses made using a five-point Likert scale, where 1 represents "completely disagree" and 5 represents "completely agree": 1) satisfaction with teaching methods, 2) cognition of combining writing skills with language skills, 3) cognition of combining writing skills with humanistic literacy, 4) cognition of combining writing skills with research awareness. Since all the participants were Chinese, the distribution and collection of the questionnaire were conducted in a Chinese language context. The questionnaire was reviewed and approved by two experts in psychometrics. The English version is for reference only, with the Chinese version being the authoritative text.

Results. The author used SPSS27.0 software to conduct variance analysis on the questionnaire results, as shown in Table 1.

Table 1. Results of Questionnaire Survey

	Teaching method satisfaction	Cognition of combining writing skills with language skills	Cognition of combining writing skills with humanistic literacy	Cognition of combining writing skills with research awareness
Ms. Li	3.8	4.1	3.6	3.5
Mr. Zhang	4.0	3.9	3.7	3.6
Mrs. Wang	3.7	3.8	3.8	3.7
F value	0.56	0.42	0.36	0.43
P value	0.579	0.661	0.701	0.653

The figures in the table represent the average scores of each variable dimension, the *F* value represents the statistical quantity of variance analysis, and the *P* value represents the significance test result of variance analysis. Generally speaking, if the *P* value is less than 0.05, the difference is considered significant. From the table, it can be seen that the scores of the three teachers in the four dimensions of teaching method satisfaction, cognition of integrating writing skills with language skills, cognition of integrating writing skills with humanistic literacy, and cognition of integrating writing skills with research awareness are fairly close, and the *P* values are all greater than 0.05, indicating that there is no significant difference in the performance of the three teachers in these four dimensions.

However, despite the statistical results showing no significant difference, some trends can still be observed. For example, Mr. Zhang has the highest score for teaching method satisfaction, while Ms. Li has the highest score for cognition of integrating writing skills with language skills. These trends, although not statistically significant, still hold reference value for the improvement of teaching methods and enhancement of teaching quality.

3.2.3. Interviews

Participants and Questions. Interviews can provide more in-depth insights and understanding. The interviewees included the aforementioned three teachers and 15 students (five from each class). Each interview was conducted in a quiet environment, lasting approximately 60-90 minutes, primarily discussing teachers' and students' understanding, feelings, and suggestions for improvement regarding English writing courses. The interview results showed that most teachers and students recognize the importance of writing skills, humanistic literacy, and research awareness, and they hope to have more practical opportunities and specific guidance to enhance these abilities. Questions include:

1. Experience and suggestions for improvement regarding teaching methods;
2. Understanding and suggestions for integrating writing skills with language skills, humanistic literacy, and research awareness;
3. Confusions, challenges, and solutions.

Results. The author conducted a content analysis of the interview results, interpreting the meaning of the text data to further verify and deepen the results of the questionnaire survey and course observation. Firstly, during the data collation stage, all interview recordings were transcribed to obtain text data. Then, all interview records were read to get an overall understanding of the data. Next, a set of codes, i.e., labels, were generated based on the content of the data, used to mark key concepts and themes in the text, such as "enhancement of writing skills," "integration with language skills," "integration with humanistic literacy," "integration with research awareness," "satisfaction with teaching methods," "confusions and challenges encountered," etc. In the subsequent text coding, the generated codes were applied to the text, marking relevant paragraphs or sentences in the text, including multiple iterations and code modifications. In the following analysis and interpretation stage, the meaning of each code or theme was analyzed and interpreted according to the coding results, as well as their relationships, and some specific examples from the text were cited to support the interpretation. Finally, in the result verification stage, analysis and interpretation results were verified to verify the consistency between the results of course observation and questionnaire survey, as shown in Table 2.

Table 2. Content Analysis Results

Theme/Code	Freq.	Example
Enhancement of writing skills	15	"*I've noticed some of my weaknesses in writing and gradually improved them.*"
Integration with language skills	10	"*I'm trying to express my ideas better in my writing, but I still find it somewhat difficult.*"
Integration with humanistic literacy	8	"*I think the course could emphasize more on how to integrate our humanistic knowledge into writing.*"
Integration with research awareness	6	"*I'm unsure how to apply what I've learned in research to my writing.*"
Satisfaction with teaching methods	12	"*I'm very satisfied with the teachers' teaching methods; they're always willing to help.*"
Confusions and challenges encountered	20	"*I sometimes feel confused about how to organize my paper, I hope to get more guidance.*"

The results of the above content analysis reveal some key themes and views of teachers and students in the interviews. The table provides the frequency with which each theme/code was mentioned, as well as specific examples representing each theme. This can help us understand the importance of each theme in the interview and the specific views of participants on these themes. For instance, teachers and students may both think that although the course emphasizes the teaching of writing skills, there are still some issues with how to integrate language skills, humanistic literacy, and research awareness. They raised some specific confusions and challenges, such as uncertainty about how to integrate these abilities into writing, or lack of guidance on how to improve these abilities. At the same time, they made some suggestions for improvement, such as increasing opportunities for practice, providing more feedback and guidance, etc. These results provide deeper understanding and support for teaching reform, so as to design and implement targeted teaching strategies, resolve the issues raised by teachers and students, and improve teaching effectiveness.

3.3. Staged Findings and Answers

Observation results revealed teachers' challenges in integrating writing skills with language skills, humanistic literacy, and research awareness. Furthermore, interview findings highlighted students' desire for more opportunities to learn and use professional and humanistic knowledge in medicine. They also expressed interest in participating in research activities related to

writing. Both of these findings correspond to Research Question 1. The results of the content analysis revealing key themes and views of teachers and students, as well as their specific confusions, challenges, and suggestions for improvement, are in line with this question.

The results display statistical trends, such as Mr. Zhang receiving the highest score for his teaching method satisfaction and Ms. Li obtaining the highest score for her cognition of integrating writing skills with language skills according to the survey questionnaire. Although these trends are not statistically significant, they still offer insights into how differences in teaching methods and teachers' perception of skill integration can impact student satisfaction and learning achievements. These findings offer valuable indications for addressing Research Question 2.

4. Action Research

4.1. Participants and Design

Based on the results of course observation and in-depth interviews, the author designed and implemented a series of teaching reform strategies as the main part of the action research, using the university English course as the basis. The reform strategies included increasing the practicality of writing tasks, emphasizing the interdisciplinary nature of the course by exploring the practicability of integrating ideological and political education of curriculum with English language teaching, and providing more feedback and guidance. The action research lasted for one semester, a total of 12 weeks, with 64 second-year students from the Clinical Medicine major at Wenzhou Medical University chosen, and the teaching teacher was Mr. Zhang, one of the teacher subjects involved in the aforementioned classroom observation and questionnaire survey. The reasons are as follows: 1) Mr. Zhang's teaching strategies are generally recognized by students; 2) Mr. Zhang has been teaching for 15 years, focusing on the stage where research and teaching complement each other, and is good at using modern educational means with an inclusive attitude; 3) Mr. Zhang and the author have worked together in multiple project groups, one in particular related to curriculum ideology and politics, and are familiar with each other's research needs and teaching reform styles. It is worth noting that the process of action research relies on evaluation to continuously adjust reform strategies, accumulate feedback, and guide the rational and effective development of the next step of action.

4.2. The First Stage of the Action Intervention

4.2.1. Step One: Design and Implementation

During the design and implementation of the first stage, the author conducted detailed observation and recording, including factors such as students' learning attitudes, course participation, English writing ability, and understanding of medical professional knowledge. For this group of students, Mr. Zhang designed specific teaching reform strategies, including setting practical writing tasks involving medical professional knowledge and research methods, introducing medical humanistic knowledge to increase the interdisciplinarity of the course, and regularly providing feedback and guidance to help students improve their writing skills, a process which underscores implicitly the practice of ideology and politics education. In designing these strategies, the teacher used focus groups to have in-depth discussions with students, designed specific teaching reform strategies to enhance their writing skills and interdisciplinary literacy.

In terms of implementing writing tasks involving medical professional knowledge, sense of ideology and politics, and research methods, Mr. Zhang designed writing tasks that are practical, relevant to actual and social phenomena, and involve medical professional knowledge and research methods, according to the English writing course and students' professional backgrounds. Students were asked to write a research report in English about a specific disease, using key language chunks and covering the cause of the disease, symptoms, treatment methods, and prevention measures. In the process of compiling the report, students not only exercised their language skills, used medical knowledge, but also adopted research methods such as literature review, data analysis, and argument construction.

Regarding the introduction of medical humanistic knowledge to increase the interdisciplinarity of the course, Mr. Zhang integrated a large amount of medical humanistic knowledge into the course to enhance the interdisciplinarity of the course. For example, students read extra-curricular English articles on themes such as medical ethics, doctor-patient relationships, and equitable health, and reflected on and discussed these themes in writing. Mr. Zhang also used a blended teaching model of online and offline, providing videos and lectures by scholars in the field of medical humanities, allowing students to listen and use the professional knowledge and insights in the videos in their writing tasks, cultivating their humanistic literacy and critical thinking.

In terms of regularly providing feedback and guidance to help students improve their writing skills, it was observed that Mr. Zhang regularly provided feedback and guidance on students' writing to help them improve their writing skills. Whenever students completed a writing task, the teacher used peer review scaffolding teaching, with a scoring rubric, allowing students to read and comment on each other's work. Based on the students' work and peers' feedback, Mr. Zhang provided more professional feedback and guidance, such as pointing out possible issues in students' language expression, argument logic, and reference to materials, and provided suggestions for improvement. He also shared examples of excellent writing for students to learn from and imitate.

During the first stage of the aforementioned action intervention, Mr. Zhang continuously observed and assessed students' progress in writing in order to timely adjust teaching strategies. At the same time, students were encouraged to provide feedback and suggestions on teaching methods, to better meet learning needs.

4.2.2. Step Two: Observation and Discovery

After implementing the reform strategies, the author continued to conduct detailed observation and recording,

including students' performance in classroom activities, such as participation in classroom discussions, commitment to writing tasks, and acceptance of teacher feedback. The reaction of the students to the new teaching method was assessed by directly observing their performance in class. The specific observation indicators include: 1) Classroom participation, i.e., the number and quality of student speeches in classroom discussions, and their responses to other students' speeches; 2) Commitment to writing tasks, i.e., the time students spend on writing tasks in class and after class, and their concentration level during the writing process; 3) Acceptance of teacher feedback, i.e., the situation of students receiving teacher feedback, including their understanding of the feedback, and how they apply these feedback in subsequent writing. Based on the observation notes, it can be confirmed that students actively cooperated with the new teaching method, spent more time and energy on writing tasks than before, and were satisfied with the teacher's feedback.

Secondly, when analyzing students' writing discourse, the author, together with Mr. Zhang, focused on students' performance in language expression, argument logic, and reference to materials. We scored each piece of work according to a pre-set scoring standard. The scoring standards include accuracy and fluency of language, clarity and rationality of argument, sufficiency and effectiveness of argument, rationality, and coherence of structure. See Table 3.

Table 3. Scoring Standards for Writing Exercises

Scoring Item	Scoring Basis	Score Range
Language Accuracy	Correctness of sentence structure, appropriateness of vocabulary, number of grammar and spelling errors	1-5
Language Fluency	Coherence of sentences, transition of paragraphs, overall fluency of the article	1-5
Argument Clarity	Explicitness of argument, effectiveness of topic sentence, relevance of argument and evidence	1-5
Evidence Adequacy	Number of evidence, quality of evidence, relevance of evidence and argument	1-5
Structural Rationality	Effectiveness of introduction, organization of paragraphs, summarizing nature of conclusion	1-5

Before the implementation of teaching reform, students were assigned to write in class, and the works produced in class were pre-test works with pre-test scores, and students' writing works were collected to generate baseline data. Based on the implementation of the above teaching reform strategies, including practical writing tasks, introduction of medical humanistic knowledge, regular feedback and guidance, etc. After the implementation of teaching reform, students' writing works were collected again, and a composition similar to the pre-test writing topic and similar requirements for writing skills and information literacy, research awareness was assigned. Students were also required to complete it in class. The works produced in class were post-test works, and the scores were post-test scores. Both pre-test and post-test scores use pre-set scoring standards, and the author and Mr. Zheng score the works separately. When the scores are significantly different, the final score is coordinated through discussion or third-party review to ensure the validity of the scores. Finally, SPSS 27.0 was used to conduct a paired samples *t*-test to compare students' writing scores before and after teaching reform. See Table 4.

Table 4. Comparison of Pre-test and Post-test Scores

Scoring Item	Average Pre-test Score	Average Post-test Score	*t*	*P*
Language Accuracy	3.487	4.213	-7.86	0.003
Language Fluency	3.524	4.316	-8.22	0.004
Clarity of Argument	3.586	4.402	-7.91	0.001
Sufficiency of Evidence	3.462	4.319	-8.04	0.005
Structural Rationality	3.541	4.378	-7.95	0.002

In the above table, the *t*-value indicates the statistical significance of the difference in scores for each scoring item between the pre-test and post-test, and the *P*-value indicates whether this difference reaches a significant level ($p < .05$ indicates a significant difference). From the data, it can be seen that after the implementation of teaching reform, students' average scores on all scoring items have significantly improved, demonstrating that the teaching reform strategies included in the first round of action intervention are effective. Specifically, students have made significant progress in language accuracy, language fluency, clarity of argument, sufficiency of evidence, and structural rationality, and their writing skills have been effectively improved.

The author designed another questionnaire survey (see Appendix 2) titled *Evaluation on the First Round of Teaching Reform* to collect students' feedback. The questionnaire included some multiple-choice and open-ended questions. The multiple-choice part used the Likert scale, allowing students to rate some statements, such as "*I am satisfied with the new teaching method*" (1=completely disagree, 5=completely agree). The open-ended question part allowed students to put forward their own opinions and suggestions on teaching reform, such as "*What are the advantages and disadvantages of the new teaching method*?" and "*What suggestions do you have for improving the teaching method*?".

After collecting the students' questionnaire answers, the author used SPSS27.0 software to analyze the results. Descriptive statistical analysis was used to obtain the mean and standard deviation of each item of data. The standard deviation is an indicator of the dispersion of the data distribution, which can help understand the variability of the data. A lower standard deviation means that most data are close to the mean, while a higher standard deviation means that the data are more widely distributed around the mean. See Table 5.

Table 5. Questionnaire Survey Results

Item	Average Score	Standard Deviation
Satisfaction with the New Teaching Method	4.523	0.712
Investment in Writing Tasks	4.318	0.806
Acceptance of Teacher Feedback	4.726	0.677
Participation in Classroom Discussions	4.614	0.703
Improvement in Writing Skills	4.402	0.889

The data shows that the standard deviations of all items are within 1, indicating that students' evaluations of these items are quite consistent, with no significant differences. Especially for "Acceptance of Teacher Feedback," its standard deviation (0.677) is the smallest, which shows that students' acceptance of teacher feedback is very consistent, reflecting the general recognition of teacher feedback among students. At the same time, the average score of all items is above 4, indicating that students are satisfied with the new teaching method, investment in writing tasks, acceptance of teacher feedback, participation in classroom discussions, and improvement in writing skills. Especially for "Acceptance of Teacher Feedback" and "Participation in Classroom Discussions," their average scores (4.726 and 4.614 respectively) are higher, indicating that teacher feedback and classroom discussions play a key role in improving students' writing skills.

When dealing with the answers to the open-ended question part, the author used a three-level coding process guided by the Grounded Theory to generate open coding, axial coding, and selective coding. See Table 6.

Table 6. Results of Three-level Coding (1)

Open Coding	Axial Coding	Selective Coding
Increased participation	Advantages	Effectiveness of the Teaching Method
Improved writing skills		
Teacher feedback helps progress		
Writing tasks are difficult	Disadvantages	Improvement of the-Teaching Method
Need more practice opportunities		
Hope to introduce more medical knowledge	Suggestions for Improvement	
Hope to have more feedback and guidance		

Open coding is the initial classification of the raw data, axial coding is the further integration of open coding, and selective coding is the summary and refinement of axial coding. Indicated by the results, students believe that the new teaching method helps to increase their participation and improve writing skills, they are satisfied with the teacher's feedback, reflecting the advantages of the teaching method, and the positive effects of the teaching reform strategies implemented in the first stage of action intervention. At the same time, students also pointed out some disadvantages and suggestions for improvement, such as the difficulty of writing tasks, the need for more practice opportunities, the hope for more medical knowledge to be introduced, and the hope for more feedback and guidance, etc., providing direction for aspects that need to be paid attention to and improved in future teaching reform.

In general, the results of the first stage of action intervention all indicate that under the intervention of teaching reform, whether students have significantly improved in areas such as language expression, argument logic, and referencing of materials, the strategies have been widely recognized among students, and the effect is significant.

4.2.3. Step Three: Reflection

In the reflection phase, the author and Mr. Zhang used the data and results generated from the first stage of intervention to deeply analyze and evaluate the results, identify the efforts that should be made and the problems that should be avoided in the second stage of teaching reform, such as practical writing tasks can increase students' participation, the introduction of medical humanities knowledge and ideological and politics awareness can enhance the interdisciplinarity of the course, and regular feedback and guidance can effectively improve students' writing skills. At the same time, the design of writing tasks can be further optimized, and the ways of feedback and guidance can be more diversified. Based on this, a detailed action plan was developed, clarifying the strategies that need to be optimized in the next stage and the goals expected to be achieved.

4.3. The Second Stage of The Action Intervention

4.3.1. Step One: Design and Implementation

In the second stage, the author and Mr. Zhang optimized the teaching strategies based on the reflection results of the first stage. First, the design of writing tasks was optimized to better attract students' interest. For example, the writing tasks were made more specific, making them closer to students' actual life and subject learning, and assigning English composition exercises such as Discuss your views on the recent hot topic of vaccination, and support your views with scientific facts.

Second, the ways of feedback and guidance were diversified to meet the needs of different students. For example, peer review, WeChat group online Q&A, and one-on-one online or face-to-face feedback meetings were introduced to ensure that students could receive timely, specific, and targeted feedback and guidance.

4.3.2. Step Two: Observation and Discovery

Following the implementation of the new reform strategy, the author once again conducted observations and recordings, including the performance of students in new writing tasks, in-class assignments, and on-the-spot outputs. Notably, the topics, difficulties, and evaluation indicators of the assignments were similar to those in the first phase (see Table 1), therefore the post-test scores of the first phase became the mid-test scores, and the assignment scores of this phase became the post-test scores, as shown in Table 7. The data of the post-test scores were analyzed in detail, using ANOVA single-factor variance analysis to compare the pre-, mid-, and post-test scores. The results showed that after adjusting the teaching strategies, there were significant improvements in areas such as the quality of completion of writing tasks,

class participation, and satisfaction with teaching.

Table 7. Comparison of Pre-test, Mid-test, and Post-test Scores

	Language Accuracy	Language Fluency	Clarity of Argument	Adequacy of Evidence	Structural Rationality
Pre-test	3.487	3.524	3.586	3.462	3.541
Mid-test	4.213	4.316	4.402	4.319	4.378
Post-test	4.512	4.619	4.689	4.603	4.673
F	37.52	40.28	39.68	38.91	39.21
P	0.001	0.003	0.001	0.004	0.002

As shown in the table, the post-test scores improved compared to the mid-test scores, reflecting the lasting effect of the teaching reform. All *P*-values are less than .001, indicating that the increase in scores from pre-test to post-test is statistically significant and effective in the five scoring items. The specific p-values in the table provide a more precise level of significance, enhancing the accuracy and credibility of the research results.

To gain a deeper understanding of the impact of the new teaching strategy, the author randomly selected 15 students for in-depth interviews. The topics of the interviews included students' understanding of the new teaching strategies adopted in the second phase intervention, their feelings about the new writing tasks, and their evaluations of diversified feedback and guidance methods. The author then collected interview feedback and conducted a detailed analysis of the data. The interview results were coded using grounded theory, resulting in the following core category nodes, as shown in Table 8.

Table 8. Results of Three-Level Coding (2)

Open Coding	Axial Coding	Selective Coding
Tasks are more practical	Optimization of Task Design	Effects of Teaching reform
Received more feedback	Diversification of Feedback Methods	
Increased classroom participation	Change of Learning Attitude	
Improved writing ability	Improvement of Learning outcomes	
Hope for more practice opportunities	Suggestions for Improvement	Improvements in Teaching Reform
Wish to introduce more medical knowledge		

Comparing Tables 6 and 8, the author concludes as follows: The results of the three-level coding guided by grounded theory each present different reactions of students to the teaching reform. Although the open coding in the two tables is slightly different, the themes of their axial coding and selective coding are consistent, namely "Effects of Teaching Methods" and "Improvements in Teaching Methods".

In Table 6, open coding includes positive feedback such as "Increased Participation", "Improved Writing Skills", and "Teacher Feedback Helps Progress", as well as suggestions for improvement such as "Writing Tasks Are Challenging", "Need More Practice Opportunities". In Table 8, open coding includes positive feedback like "Tasks Are More Practical", "Received More Feedback", "Increased Classroom Participation", "Improved Writing Ability", as well as suggestions for improvement like "Hope for More Practice Opportunities", "Wish to Introduce More Medical Knowledge". The coding in both tables is closely related to the effects and improvements of teaching reform, reflecting students' positive evaluations and constructive suggestions for the teaching reform under the two-stage intervention, which provides a strong basis for further optimizing the teaching reform strategy and improving teaching effectiveness.

Overall, the research results of the second phase of action intervention show that after strategic adjustments, there is further improvement in students' participation, learning gains, and satisfaction. The empirical research provides valuable information for the implementation effectiveness of teaching reform strategies and future directions for improvement.

4.4. Overall Reflection

The actions taken in the two stages of teaching reform, as outlined above, have received support from research results, demonstrating their effectiveness in enhancing students' writing skills, humanistic literacy, and scientific research awareness, as answers to Research Question 3. Not only have students exhibited improved language skills in writing tasks, but they have also shown a better understanding of humanities knowledge and attention to scientific research, which are two crucial aspects of ideological and politics awareness. In addition, they have given positive feedback about this reformative teaching method, finding it more conducive to their learning and development.

Through two stages of action intervention, the author finds that teaching reform is a continuous process that requires constant designing, implementing, observing, reflecting, and adjusting. In this process, teachers have also improved their teaching abilities and the effects of reformative action based on reflection and research.

5. Discussion and Implications

5.1. Research Result Discussion

The study's findings are in alignment with previous literature in several ways. Foremost, the study supports

the idea of Content and Language Integrated Learning (CLIL), a method that emphasizes the simultaneous improvement of students' subject knowledge and language skills, as a beneficial teaching approach in medical English instruction. Through the utilization of CLIL, the study found that students improved their English language skills while learning medical professional knowledge. These findings echo earlier research that suggested the successful practices of CLIL in other academic fields could have potential theoretical and practical foundations for medical English teaching (Morton, 2013; Nikula, Dalton-Puffer, & Llinares, 2013; Pérez-Cañado, 2012).

Furthermore, the findings also support the idea of integrating ideological and political education into the teaching process, which was previously identified as a significant position in educational research (Li & Wang, 2021; Bai & Feng, 2021). The investigation found that introducing medical students to social, political, and ethical issues within the English language classroom could enhance their humanistic literacy, aligning with the research aim to integrate constructivism and the CLIL theoretical framework to enhance students' language skills, humanistic literacy, and research awareness.

However, the current study goes beyond the existing literature by providing concrete strategies for executing these theoretical approaches. Previous research had identified a gap in how to specifically integrate these concepts into medical college English teaching (Llinares and Dafouz, 2020), and how to implement problem-oriented teaching methods to enhance students' research awareness (Khan, Taqui, Khawaja, & Fatmi, 2007; Healey, Flint & Harrington, 2016). The current study addresses these gaps by demonstrating how constructivism and CLIL can be integrated into the actual teaching process through practical opportunities and specific guidance from teachers.

The study offers pedagogical implications derived from constructivism and CLIL by suggesting that these theories need to be integrated into the teaching process. Teachers should provide sufficient practical opportunities and specific guidance to help students understand and master these abilities. In addition, teaching reform using these theories needs continuous evaluation and adjustment to ensure its effectiveness and adaptability. This aligns with Dalton-Puffer's (2007) assertion that the application of CLIL needs to fully consider the specific context of the teaching environment, including the communicative strategies of teachers and students, as well as the challenges of using a second language in scientific communication.

In conclusion, the study's findings are in line with the existing literature that supports the integration of constructivism and CLIL into medical English teaching. However, it goes a step further by offering practical strategies and continuous evaluation frameworks for implementation, addressing identified gaps in the literature. This provides a valuable contribution to the field, offering potential pathways for the effective integration of language skills, humanistic literacy, and research awareness in medical English teaching.

5.2. Pedagogical and Curriculum Implication

This study relies on data and empirical analysis, revealing the role of the teaching syllabus, teaching activities, and assessment strategies in enhancing medical students' language skills, humanistic literacy, and scientific research awareness. The rational design of teaching activities in English classes at medical schools, such as discussions, writing, and group tasks, is key to enhancing students' language skills, humanistic literacy, and scientific research awareness under the inspiration of interdisciplinary fields. Besides, optimizing the teaching syllabus, teaching activities, and assessment strategies can effectively enhance students' language skills, humanistic literacy, and scientific research awareness.

The author proposes that the integration of constructivism, CLIL, and curriculum ideology and politics can effectively solve the core problem of enhancing medical students' language skills, humanistic literacy, and scientific research awareness. Each theory has its unique application in each teaching goal, and these applications can support each other to jointly promote the achievement of teaching goals. See Table 9.

Table 9. The Integration of Constructivism, CLIL, and Curriculum Ideology and Politics

Ability	Constructivism	CLIL	Curriculum Ideology and Politics
Language Skills	Through designing various writing tasks, students can improve their language skills in the actual writing process	By teaching medical professional content, students can improve their English skills in reading and writing	During the discussion of medical topics, guide students to use correct and accurate language to express their views
Humanistic Literacy	Introduce humanistic themes in medicine, allowing students to improve their humanistic literacy in the process of discussing and writing these topics	By teaching medical humanities content, students can improve their humanistic literacy in reading and discussing	Guide students to discuss medical ethical issues, reflect on doctors' social responsibilities, and cultivate moral awareness
Scientific Research Awareness	Have students read and write scientific papers to enhance scientific research awareness	By teaching scientific research content, students can enhance their scientific research awareness in reading and practice	Guide students to view scientific research activities from a moral and ethical perspective, cultivating a sense of social responsibility

6. Conclusion

This research provides an in-depth perspective on how to enhance medical students' language skills, humanistic literacy, and scientific research awareness by optimizing the teaching syllabus, teaching activities, and assessment strategies under the viewpoint of constructivism and Content and Language Integrated Learning (CLIL), and the perspective of curriculum ideology and politics. By combining interviews and action research methods for teaching reform, it provides empirical evidence on how the rational design of teaching activities in English writing classes in medical schools can enhance medical students' language skills, humanistic literacy, and scientific research awareness, offering guidance for future teaching reform. Future research should continuously carry out action research to further improve teaching methods and better meet students' learning needs. This study is hoped to have shared the results of this research to provide other teachers and education researchers with insights and references for teaching reform.

Yu Pan, born in July 1983, is a lecturer at School of Foreign Language Studies at Wenzhou Medical University. Her research interests are TESOL, Teacher Learning, and Language and Modern Linguistics.
Email: 153783936@qq.com

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix 1

课程学习与自我成就的评价问卷

以下是一份针对英语写作课程的量化问卷设计，采用李克特五分量表作答，其中 1 代表“完全不同意”，5 代表“完全同意”。请直接勾选答案。

1. 教学方法满意度

1.1 我对教师的教学方法感到满意

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

1.2 我认为教师的教学方法对我有所帮助

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

1.3 我认为教师的教学方法能够激发我的学习兴趣

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

1.4 我认为教师的教学方法能够帮助我理解和应用知识

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

1.5 我愿意推荐教师的教学方法给其他同学

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

2. 写作技能与语言技能结合的认知

2.1 我认为写作技能与语言技能的结合对我有所帮助

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

2.2 我认为写作技能与语言技能的结合能够提升我的英语水平

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

2.3 我认为写作技能与语言技能的结合能够提升我的写作水平

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

2.4 我认为写作技能与语言技能的结合能够提升我的表达能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

2.5 我认为写作技能与语言技能的结合能够提升我的思考能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

3. 写作技能与人文素养结合的认知

3.1 我认为写作技能与人文素养的结合对我有所帮助

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

3.2 我认为写作技能与人文素养的结合能够提升我的文化素养

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

3.3 我认为写作技能与人文素养的结合能够提升我的批判性思考能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

3.4 我认为写作技能与人文素养的结合能够提升我的创新能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

3.5 我认为写作技能与人文素养的结合能够提升我的人文关怀能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

4. 写作技能与科研意识结合的认知

4.1 我认为写作技能与科研意识的结合对我有所帮助

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

4.2 我认为写作技能与科研意识的结合能够提升我的科研能力

（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

4.3 我认为写作技能与科研意识的结合能够提升我的数据分析能力
（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）
4.4 我认为写作技能与科研意识的结合能够提升我的实验设计能力
（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）
4.5 我认为写作技能与科研意识的结合能够提升我的科研道德和责任感
（1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意）

Evaluations of Course Learning and Self-Achievement

Here is the English version of the questionnaire. This is a quantitative questionnaire designed for an English writing course, using a Likert five-point scale, where 1 represents “Strongly Disagree” and 5 represents “Strongly Agree”. Please directly tick the answer.

1. Teaching Method Satisfaction
   1.1 I am satisfied with the teacher's teaching methods.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   1.2 I think the teacher's teaching methods are helpful to me.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   1.3 I think the teacher's teaching methods can stimulate my interest in learning.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   1.4 I think the teacher's teaching methods can help me understand and apply knowledge.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   1.5 I am willing to recommend the teacher's teaching methods to other students.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

2. Perception of the Integration of Writing Skills and Language Skills
   2.1 I think the integration of writing skills and language skills is helpful to me.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   2.2 I think the integration of writing skills and language skills can improve my English level.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   2.3 I think the integration of writing skills and language skills can improve my writing level.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   2.4 I think the integration of writing skills and language skills can improve my expressive ability.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   2.5 I think the integration of writing skills and language skills can improve my thinking ability.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

3. Perception of the Integration of Writing Skills and Humanities Literacy
   3.1 I think the integration of writing skills and humanities literacy is helpful to me.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   3.2 I think the integration of writing skills and humanities literacy can improve my cultural literacy.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   3.3 I think the integration of writing skills and humanities literacy can enhance my critical thinking ability.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   3.4 I think the integration of writing skills and humanities literacy can enhance my innovation ability.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)
   3.5 I think the integration of writing skills and humanities literacy can enhance my capacity for humanistic care.
   (1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

4. Perception of the Integration of Writing Skills and Research Consciousness

4.1 I think the integration of writing skills and research consciousness is helpful to me.

(1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

4.2 I think the integration of writing skills and research consciousness can improve my research ability.

(1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

4.3 I think the integration of writing skills and research consciousness can enhance my data analysis ability.

(1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

4.4 I think the integration of writing skills and research consciousness can enhance my experiment designability.

(1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

4.5 I think the integration of writing skills and research consciousness can enhance my research ethics and responsibility.

(1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree)

Please return the completed questionnaire to the researcher. Thank you for your participation!

Appendix 2

首轮教学改革评估问卷

第一部分 列克特量表问题

请根据您对以下陈述的认同程度，在 1 到 5 之间打分（1=完全不同意，5=完全同意）。请直接在你的答案前打勾。

1. 新的教学方法增强了我的学习体验。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
2. 分配的写作任务有助于提高我的写作技巧。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
3. 老师提供的反馈是有洞察力和建设性的。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
4. 与教学改革前比，我现在更积极参与课堂讨论。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
5. 教学改革显著提高了我的写作技巧。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
6. 分配的写作任务量适中。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
7. 写作任务的要求清晰、易懂。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
8. 我有信心完成分配的写作任务。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
9. 老师的反馈及时且频繁。
   (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
10. 课堂讨论充满活力且富有成效。
    (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
11. 老师在课堂上的解释清楚且有帮助。
    (1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
12. 课程提供的资源（如教科书、在线材料等）有用。

(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)

13. 教学改革提高了我书面表达自己的能力。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
14. 教学改革提高了我写作中的论证逻辑。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
15. 教学改革提高了我在写作中引用材料的能力。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
16. 教学改革增加了我对课题的兴趣。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
17. 教学改革提高了我整体的学术表现。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
18. 我会向其他学生推荐这次教学改革。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
19. 我期待未来有更多的教学改革。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)
20. 总体来说，我对教学改革感到满意。
(1=完全不同意；2=不同意；3=中立；4=同意；5=完全同意)

第二部分 开放性问题

请对以下问题提供详细的回答：

1. 新的教学方法中，哪些具体方面对你最有益?
2. 你在新的教学方法或写作任务中遇到了哪些挑战?
3. 自从实施教学改革，你是否注意到你的写作或其他技能有任何具体的提升？如果有，请具体指出。
4. 如果你可以对教学改革提出一个改进建议，那会是什么？为什么?
5. 你能分享一个与教学改革相关的特别经历（积极或消极）吗？这个经历对你的学习有重大影响吗？

感谢您的参与。您的反馈对于改进教学方法和策略至关重要。

Evaluation on the First Round of Teaching Reform Questionnaire

Part 1 Likert Scale Questions

Please rate your agreement with the following statements on a scale from 1 to 5 (1 = Completely Disagree, 5 = Completely Agree). Please directly tick the answer.

1. The new teaching method has enhanced my learning experience.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
2. The writing tasks assigned are helpful for improving my writing skills.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
3. The feedback provided by the teacher is insightful and constructive.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
4. I am more engaged in classroom discussions now than before the teaching reform.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
5. The teaching reform has significantly improved my writing skills.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
6. The volume of writing tasks assigned is appropriate.
(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
7. The requirements of the writing tasks are clear and understandable.

(1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)

8. I feel confident in completing the writing tasks assigned.
   (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
9. The teacher's feedback is timely and frequent.
   (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
10. The classroom discussions are engaging and productive.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
11. The teacher's explanations during class are clear and helpful.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
12. The resources provided for the course (e.g., textbooks, online materials) are useful.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
13. The teaching reform has improved my ability to express myself in writing.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
14. The teaching reform has improved my argument logic in writing.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
15. The teaching reform has improved my ability to reference materials in my writing.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
16. The teaching reform has increased my interest in the subject.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
17. The teaching reform has improved my overall academic performance.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
18. I would recommend the teaching reform to other students.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
19. I am looking forward to more teaching reforms in the future.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)
20. Overall, I am satisfied with the teaching reform.
    (1=Completely Disagree; 2=Disagree; 3= Neutral; 4=Agree; 5=Completely Agree)

Part 2 Open Questions

Please provide detailed responses to the following questions:

1. What specific aspects of the new teaching method have been most beneficial to you?
2. What challenges have you encountered with the new teaching method or writing tasks?
3. Have you noticed any specific improvements in your writing or other skills since the implementation of the teaching reform? If so, please specify.
4. If you could suggest one improvement to the teaching reform, what would it be and why?
5. Can you share a particular experience (positive or negative) you had related to the teaching reform that significantly affected your learning?

Thank you for your participation. Your feedback is invaluable in improving the teaching methods and strategies.