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# How do students' learning goals differ? A text mining approach to reveal the individual differences

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Extensive research has demonstrated that setting learning goals could benefit academic performance, learning motivation, and attendance rate. The current research further focused on the content of learning goals with the text mining approach. This research uncovered three main differences between high-achieving students and their counterparts. Specifically, high-achieving students exhibited a higher tendency to devise goals aligning with the course objectives. They were more driven by their desire for academic excellence and personal growth. Lastly, they expressed themselves with higher linguistic alignment with the context. This research enriched the understanding of the characteristics of learning goals and provided practical implications for educators to develop a more inclusive and supportive learning environment that address diverse student needs.

KEYWORDS

**goal setting strategies, academic performance enhancement, learning goals effectiveness, text mining analysis, goal specificity and difficulty, student goal variations, low-achieving students support, goal relevance and structure**

## Introduction

Goal setting is fundamental to motivation and is crucial to achieving desired outcomes across various domains, including education (Locke and Latham, 2002; Latham and Locke, 2007). Previous research has investigated goal setting's impact on various aspects such as academic performance, learning motivation, persistence in problem-solving, and attendance rates (Pintrich, 2000; Elliot and McGregor, 2001; Hattie and Timperley, 2007; Latham and Locke, 2007; Zimmerman and Kitsantas, 2014). They converged to support the benefits of goal setting. Furthermore, researchers have also begun to focus on the content of learning goals and tried to identify what goals work best for learning. Specifically, some studies found that setting specific, challenging, and measurable goals is the most beneficial. Other studies highlighted that goal-framing or communication could be a possible way to enhance the effectiveness of goal setting (Dweck, 2006; Yeager and Dweck, 2012). Compared to the mindset focusing on achieving a certain grade or score, their studies showed that learning goals highlighting the importance of learning and personal growth can foster a more positive approach to learning. However, previous studies on goal settings predominantly focused on the consequence of learning goals and fell short of considering the learning goals' content. In this research, we propose a text-mining approach to examine learning goals. Text mining enables us to examine large

volumes of unstructured data and explore the intricate patterns and relationships within the data. Such an analysis could explore the uniqueness of students' expression of their own goals, including the content, usage, and characteristics of wordings. An earlier attempt using a text-mining approach to analyze learning goals discovered the similarities and differences in the learning goals of high-performing and struggling students (Ng and Chan, 2023).

The current research further focuses on the differences between high-achieving students and their counterparts. Gaining a comprehensive understanding of learning goals could facilitate us to provide valuable insights into education and develop strategies to guide students to set goals that align with their individual needs. It is also facilitative to developing targeted interventions tailored to specific student populations (e.g., Zurlo et al., 2020; Williams et al., 2021). For example, if the learning goals of struggling students differ from those of high-performing students, training can be implemented to scaffold the goal-setting activities for these students. Additional support, guidance, and resources can be developed based on the high-performing students to help the struggling students to set goals. Understanding the differences between high-performing students and their counterparts can also shed light on the potential challenges different student groups face. By addressing these differences, educators can create a more inclusive and supportive learning environment that caters to diverse student needs by advancing the theoretical and practical implications.

## The current study

This study aims to investigate how the content and structure of learning goals impact academic performance in order to identify strategies to assist low-achieving students in goal-setting. Text mining could delve into the complexities of learning goals and uncover patterns and relationships not apparent through traditional research methods. Analyzing written goal descriptions would offer a deeper understanding of goal-setting nuances, such as specificity, difficulty, and goal relevance (Locke and Latham, 2002; Latham and Locke, 2007), compared to previous studies. In this study, we aim to address the following research questions:

1. What are the specific characteristics of learning goals among high-achieving students compared to their counterparts?
2. How do the learning goals of high-achieving students differ in relation to their course grades?

## Method

A final dataset constituting 552 valid responses collected from 184 students was used. This data was collected from the first tutorial lesson of 192 students attending a course at a university in Hong Kong. They were asked an open-ended question: *What are your learning goals in this course?*. They were then invited to complete three sentence statements in their native language (i.e., Chinese) that begin with *I want to.* Their responses were submitted to an online platform such that they could receive an email about their goals. They could regularly check back on their goals. All the students provided informed consent before they completed the learning activity.

We analyzed the data using the Voyant Tool (Sinclair and Rockwell, 2020). This free, open-source, web-based application supports the text-mining process of qualitative data, including text from interviews, books, and open-ended questions. The Voyant Tool allows us to focus on specific segments of the whole corpus and conduct text analytics to study term frequencies and distributions within individual documents and across a collection of documents. Moreover, Voyant Tool also supports multiple languages including Chinese characters, and hence fit the language used in the current research. Figure 1 displays a screenshot of the working environment in the Voyant Tool. There are five default functions, including **cirrus**, which enables users to create a word cloud to visualize the top frequency words, r**eader** that enables users to display the original text for reading, **trends** that enable users to develop line graphs to depict the distribution of the word throughout the text, **summary** that provides an overview of the text such as the most frequent words and the average number of words per sentence, and **context** that shows the surrounding text of each occurrence of a selected word (Sinclair and Rockwell, 2020). These tools are useful in conducting basic analyses of the text.

In order to preserve students' original expressions, we opted not to lemmatize or tokenize the wordings of the learning goals to group them together to account for different word forms. Initially, we conducted an analysis at the overall course level to obtain a comprehensive understanding of all the responses. Table 1 summarized the features of the data, such as the total number of words and average words per sentence. Subsequently, we divided the data into four quartiles by students' final course grade to investigate the inter-group differences and examine the unique features in each quartile. The first quartile consists of 46 highest-performing students obtaining grades A and B+ in the course. The second quartile comprised 45 students whose marks were below the first quartile and achieved grades ranging from B to B+. The third quartile included another 45 students whose marks were below the second quartile and obtained grades from B to B-, while the fourth quartile comprised the remaining 46 students who struggled in the course and with marks below the third quartile, receiving grades ranging from B- to F.

### Relations to course objectives

The cirrus function provided information about the most popular keywords. These keywords are related to the course name ($f = 203$), followed by those about the academic discipline of the course ($f = 126$) and those on "study" or "learning" ($f = 56$). Additionally, a significant portion of the most frequent keywords were directly related to the course objectives, suggesting that students could align their learning goals with the course's objectives. Specifically, the course was an application-based course that focused on societal problems. It is notable that the most frequently used words in students' learning goals include keywords such as problems ($f = 32$), theories ($f = 22$), application ($f = 11$), and society ($f = 97$) (see Figure 2). Therefore, these three words (problems, theories & applications) were believed to best encapsulate the key aspects of the course content.

Moreover, the number of appearances of these keywords also correlated with students' final course grades. The highest-performing group (the first quartile) had the highest frequency of the keywords "problems" ($f = 10$), "theories" ($f = 9$), and "application" ($f = 4$). The second quartile with students who performed slightly lower had a slightly lower

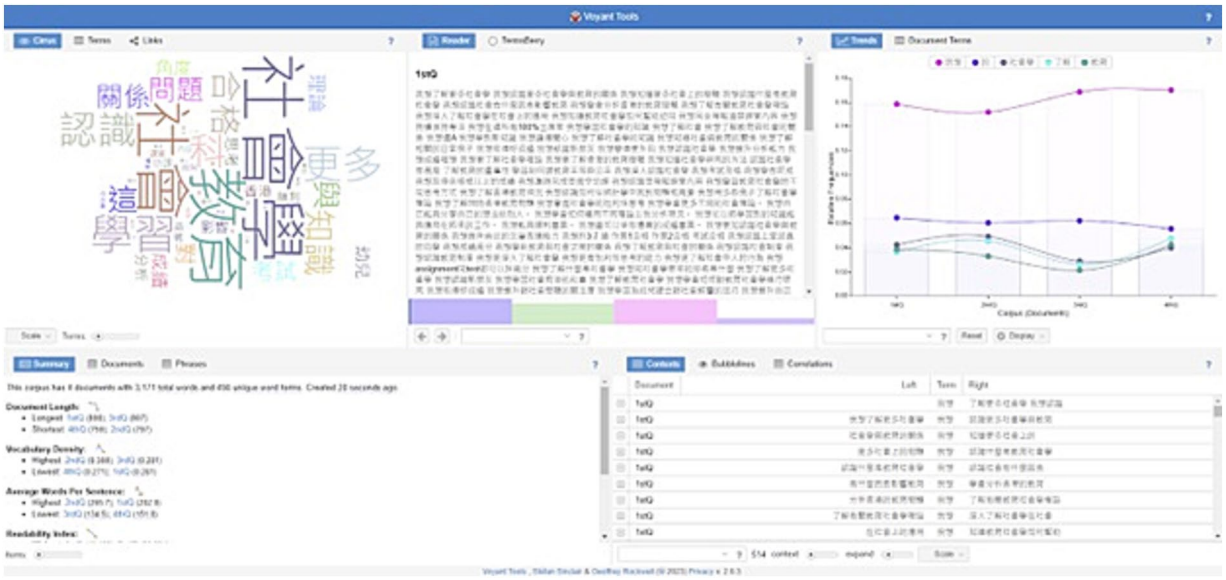

FIGURE 1
Screenshot of the working environment in the voyant tool.

TABLE 1 Basic statistics of students' response.

| Category | Metrics |
|---|---|
| Number of participated students | 184 |
| Number of valid learning goals | 552 |
| Total number of words | 5,744 |
| Average number of words per quartile | 10.72 (Q1); 10.51 (Q2); 10.34 (Q3); 10.06 (Q4) |
| Average number of words per response | 10.41 |
| Number of words in the longest response | 33 |
| Number of words in the shortest response | 1 |
| Quartile with the most words | 1st (1,479 words) |
| Quartile with the least words | 4th (1,388 words) |

figure (problems: f = 9, theories: $f = 6$, application: $f = 3$). The third quartile (students with lower grades) had further lower frequency (problems: $f = 7$, theories: f = 4, application: $f = 2$), and the fourth quartile had the lowest frequency of these keywords (problems: f = 6, theories: f = 3, application: f = 2). These findings suggest that students who performed well in the course had learning goals more closely aligned with the course objectives, demonstrating a better understanding of the course's intended learning outcomes than their counterparts. However, the implications of this finding suggested that students who are more familiar with the course objectives and can align their learning goals accordingly were associated with achieving higher grades.

## Relations to performance

Another set of popular keywords is those related to the course results. First, we identified the Chinese and English words for "pass." Then, we used the "topic" tool in Voyant tools to identify a string of wordings on the same topic. The topic tool could randomly assign words to a specific number of topics and then refine the model by an algorithm to determine which terms were best suited to the topics based on co-occurrence. As the topics were randomly created, the analysis was repeated in order to extract the maximum number of words. After generating the list, we manually select the results that are the most relevant to performances. The number of goals related to performance provided by quartile one was 22, that for quartile two was 26, that for quartile three was 29, and that for quartile four was 25. The keyword "pass" was common in all four quartiles. Because both Traditional Chinese and English are the official languages in Hong Kong, some of the students used the traditional Chinese keyword "合格" (hégé), and some of them used the English keyword "pass." Students also used slang, dialects, and abbreviations such as "炒" (chǎo) or "爛" (làn), as well as terms related to the consequences of failing the course, such as "重讀" (zhòngdú; meaning retake). As this course was a core subject required for graduation, these terms were all associated with the theme of "pass." The frequency of words related to the theme of "pass" followed a right-skewed curve, with the fourth quartile having the highest frequency ($f = 16$), followed by the third quartile ($f = 13$), and the first and second quartiles having the lowest frequency ($f = 9$).

Other goals that did not contain the keyword "pass" were focused on students who have higher expectations of themselves and aimed to achieve better results than the class average. Among the first quartile, there were 13 goals with these keywords, while the second quartile had 17, the third quartile had 16, and the fourth quartile had 9. These goals typically fall within specific grade ranges but with different types of expression, such as a letter grade (e.g., A, B+) or the grade point averages (GPA) score (e.g., 3.0, 3.3). To facilitate the analysis, we converted the letter grades into GPA scores. Following the university's regulation, 2.0 is C, 3.0 is B, and 4.0 is A. The first quartile students all aimed at the range of 3.0 to 4.0, and the second quartile usually within the range of 2.0 to 4.0, quartile three within the range of 3.0 to 4.0, and quartile four is 3.0.

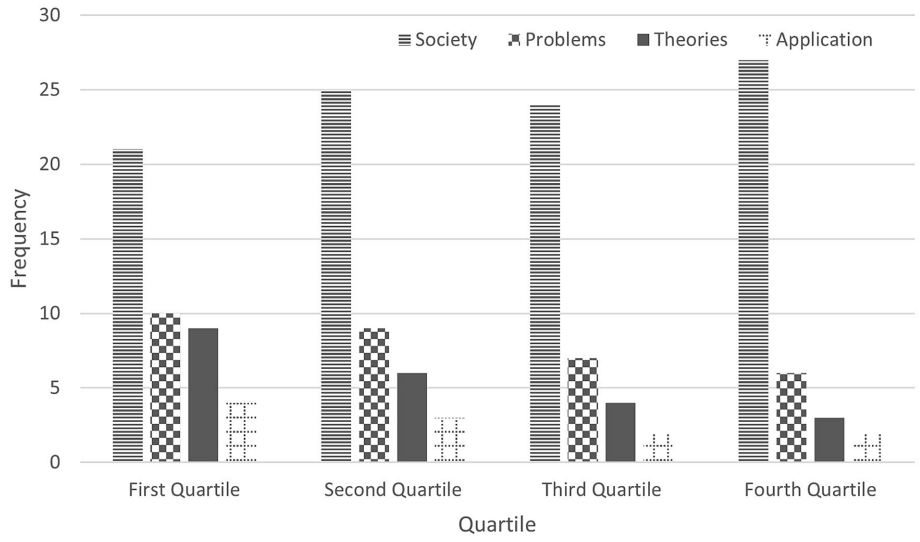


FIGURE 2
The alignment of learning goals with course objectives.

Apart from the goals explicitly mentioning exact course grades or GPA, some goals described the results more implicitly, such as "good results," "satisfactory results," or "high marks." The highest number of students who wrote this type of goal was in the second quartile ($f=11$), followed by the first and third quartiles (fs = 8), and the lowest frequency was in the fourth quartile ($f=6$).

## Relations to expression

The expression of learning goals also offered interesting insights. Hong Kong is a multilingual environment, and Hong Kong Chinese are accustomed to using Cantonese, English, and Putonghua together in their daily lives (Evans, 2011; Wang and Kirkpatrick, 2015; Bauer, 2018). However, in formal writing and academic settings, Hong Kong Chinese usually use standardized Chinese, while in conversational settings, they speak Cantonese, which includes dialectic expressions that differ from written Chinese (Bauer, 2018). Moreover, Hong Kong Chinese are trained to avoid mixing English and Chinese in the same document and to refrain from using informal English abbreviations, especially in formal situations, such as school examinations, academic assignments, and other official documents (Wang and Kirkpatrick, 2015; Bauer, 2018). Although informal language is gaining popularity, it is inappropriate in formal contexts.

To identify the slang, dialects, and English abbreviations used in the students' learning goals, we first use the textual arc tool in the Voyant Tools to quickly skim through the whole corpus and identify outliers. This tool would visualize a circle of words with the more frequently appeared words at the center and the least frequently appeared words at the peripheral. This tool helped us obtain a list of uncommon expressions that were potentially slang, dialects, and English abbreviations. Finally, a panel discussion involving two native Cantonese-speaking individuals holding master's degrees discussed every item on the list. Examples of slang include 攞 (luó, $f=4$) or 拎 (līn, f = 4), which carry the meaning of getting something, and English abbreviations include "asm" for "assignments" and "gpmate" for groupmates." The analysis revealed that quartile three had the highest frequency of learning goals containing such informal elements ($f=10$), followed by quartile four ($f=9$), while quartiles one and two had equal numbers ($f=7$).

Furthermore, it is worth mentioning that the goal-setting activity took place in a formal academic setting, and thus, students were expected to use formal writing rather than slang, dialects, or English abbreviations when writing learning goals. These findings highlighted the interplay between language use, formality, and students' commitment to their learning. The languages that students used to express their goals could reflect the extent of effort they were willing to invest in this course.

The language patterns of first quartile students, which contained the least slang and bilingual expressions, indicated a higher level of language proficiency and the ability to adjust language use in appropriate contexts. It demonstrated their awareness of the classroom's formal requirements and commitment to the course, which may contribute to their academic success.

# General discussion

Our study aims to advance the understanding of learning goals by employing text mining, a comparatively new research approach. Text mining enabled us to delve into rich textual data and extract meaningful information more objectively and systematically. Specifically, we uncovered some specific characteristics of students' learning goals and compared the differences between the high-achieving students and their counterparts. Our findings on students' use of language and its relationship to academic performance could bring valuable implications to students, practitioners, and policymakers.

## Findings on the goals related to course objectives

Our findings demonstrated that high-achieving students exhibited a higher tendency to devise goals aligning with the course

objectives. Students in the first and second quartiles more often used keywords related to course objectives, suggesting that they had a clear understanding of the course even at the very beginning. A possible explanation would be that high-achieving students have stronger self-regulated learning skills. It means that they could more effectively grasp the important information of the course, which, in turn, helped them to understand the course's intended learning outcomes. As a result, they could better align their learning goals with the course objectives and achieve better grades. In contrast, students at the bottom may have a weaker understanding of the course and learning outcome at the very beginning, making it more difficult for those students to align their goals to the course's objectives. Thus, they use comparatively fewer keywords aligning with the course objectives.

The findings also shed light on effective instructional practices. Our results suggested a potential correlation between students' understanding of the course objectives and their course grades. On the other hand, Stehle and Spinath (2014) also discovered that students' perceived achievement of intended course objectives was positively associated with teaching effectiveness as measured by students' evaluation. These benefits indicated that explicitly explaining and reinforcing the course objectives in the classroom would be an effective instructional practice.

## Findings on the goals related to performance

Our findings also revealed an interesting trend among struggling students. Previous studies on goal orientations suggested that, compared with mastery goals, those setting performance-oriented goals tended to perform poorer (e.g., Fenollar et al., 2007; Bruno et al., 2019). Consistent with this, our findings showed that low-achieving students tend to prioritize performance-related goals. Besides, we also found that the keywords related to passing the course than reaching academic excellence were more common among groups of students from the third and fourth quartiles, suggesting that they prioritize getting (just) a pass for this course as their primary aim. Our findings indicated that their goal statements are under the influence of their needs to fulfill immediate academic requirements and avoid negative outcomes and poor performance. It may be because of the compulsory nature of this course, in which students need to pass this subject for graduation. Therefore, students, especially those low-achieving and struggling to pass, may have a sense of urgency to meet this academic requirement. Struggling students may be more aware of the potential consequences and may feel compelled to focus their goals on achieving only the minimum requirement. Hence, the goal of passing the course and the need to fulfill academic obligations to progress academically had become their central focus, potentially overshadowing other broader or long-term academic aspirations. Alternatively, high-achieving students in quartiles one and two set more ambitious goals beyond mere course completion. Their goals reflected a higher confidence level and a desire to excel academically. These students may have a stronger belief in their abilities and seek to challenge themselves academically by aiming for higher grades or engaging in additional learning opportunities for personal growth. Thus, low-achieving and high-achieving students employed different strategies when setting their learning goals. Such a distinction in goal orientation highlights the importance of considering individual differences and the relationship between achievement and goal setting.

While low-achieving students prioritized performance-related goals as a strategy to meet basic academic requirements, high-achieving students were driven by their desire for academic excellence and personal growth. Such a distinction could help teachers identify potential struggling students at an earlier stage by their learning goals, thus could provide remedial support in a timely manner (Alshanqiti and Namoun, 2020; Gillam et al., 2023). Besides, teachers could also develop different interventions based on their specific learning needs (Ainscough et al., 2018). For example, the low performance-oriented goals set by the struggling students may demonstrate their pressure and fear of failing the course. Teachers should then develop a supportive environment to encourage these struggling students to seek academic help and design appropriate interventions to help them fulfill the basic course requirement. For high-achieving students, teachers could also cultivate them with a growth mindset and design challenging tasks to nurture their ambition. Teachers could also keep motivating these students toward academic excellence. Such a differentiated instructional approach could tailor instructional strategies appropriate to students' learning styles and needs, thus increasing students' engagement and outcomes (Lam et al., 2021).

## Findings on the goals findings on the goals related to expression

Our analysis has brought to light an interesting observation regarding the diversity of language used in expressing goals among students with different learning achievements. Comparing the four quartiles, we found that students in the middle ranking (the second and the third quartiles) expressed themselves with higher linguistic diversity. They used a broader range of expressions, including slang, dialects, and English abbreviations, when setting their learning goals. Such a choice of diverse language use could be attributed to various factors. A possible explanation is the multilingual environment in Hong Kong. In everyday communication, Hong Kong Chinese often use a mixture of all three languages (Wang and Kirkpatrick, 2015). While high-achieving students in the first quartile may be more proficient in using formal languages in the academic setting, other students may draw language elements from their everyday communication and use them in class. Besides, the use of language could also be influenced by social factors and peer dynamics. Students may adopt the language used by their peers or their family in order to conform to social norms and establish a sense of belonging. Hence, their environment could shape their language in expressing their goals (Higgins, 2003; Lee and Chen, 2018).

The diversity in the language used can be observed among the second and third-quartile students, suggesting that they were willing to use informal language as a means of expressing their goals, showcasing their personal identities, and reflecting social dynamics (Scharinger and Erfurth, 2022). In contrast, students in the fourth quartile gave the least responses in terms of words (see Table 1). Such a contrast hinted that students' willingness to respond and truly express themselves may correlate to their motivation and sense of belonging in class.

## Practical implications

Apart from the theoretical advancement, our study provided practical implications. By acknowledging the differences in goal setting between high-achieving students and their counterparts, students can gain insights into the goal-setting strategies that can enhance their academic performance effectively. Students should remember to aim high and achieve higher. Students, especially those who want to achieve academic excellence, should draw inspiration to set more ambitious goals and specifically extend beyond mere course completion. This knowledge empowers students to take ownership of their learning journey and make informed decisions regarding their learning goals.

By recognizing the importance of course objectives in students' learning goals, teachers should consider providing guidance on the course objectives and fostering a clear understanding of course expectations. Teachers should also help students align goals with course objectives and emphasize the importance for students to understand the intended learning outcomes.

Understanding the characteristics and language used in learning goals could help teachers address students' special needs. Teachers should incorporate language-focused interventions into their teaching practices, emphasizing the appropriate use of formal language. They should facilitate students to develop a broader range of language expressions and tailor their instructional practices to support students better.

Our adoption of text mining into educational research could also provide policymakers with valuable insights for shaping policies and practices that promote student success. Our study demonstrated the importance of language proficiency and communication skills. Policymakers can consider highlighting language proficiency and communication skills as essential curriculum components. By recognizing the importance of language adaptation and effective communication in different contexts, policymakers can ensure that language development receives adequate attention across various subjects and grade levels. Additionally, policies can be implemented to foster a positive and inclusive learning environment that values individual expression while promoting clear and precise communication.

## Limitations and future directions

There are a few caveats. First, this course is compulsory. Students must pass to graduate. Therefore, students have an urgency to get a pass. Although we have purposely asked students to list three goals to reduce such impact, the results may not be applicable to non-compulsory courses or courses with less severe consequences for failing. Moreover, conducting statistical tests is important in research. The small sample size posed challenges in conducting certain analysis, such as the chi-square test. Thus, future research could consider adopting a text-mining approach to other populations, such as other age groups, educational levels, or geographic regions. Besides, all the themes extracted are correlations in nature. The causal link between the impact of learning goals and course performance awaits future studies.

## Conclusion

Application-wise, our findings have broad implications for educators, policymakers, and researchers. By comprehending the influence of learning goals on academic outcomes, we can develop more effective goal-setting strategies, empowering students to take control of their learning and reach their full potential (Bandura, 1986; Elliot and Church, 1997; Pintrich, 2000). This knowledge contributes to a more equitable educational system that supports all students in achieving their goals and realizing their aspirations.

The insights from this study hold the potential to benefit students with lower academic performance by identifying effective goal-setting practices that can be adopted and adapted to their individual needs. By understanding the characteristics of successful goal-setting, educators can tailor interventions and strategies to support underachieving students, fostering their motivation, self-regulation, and academic success. Our research undertakes to add a novel perspective to the field of educational psychology, informing future studies, interventions, and educational practices aimed at promoting academic achievement and supporting students from all levels of achievement in reaching their goals. With this knowledge, it is hoped to push forward a more equitable educational system that supports all students in achieving their goals and realizing their aspirations.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies have been approved by Hong Kong Metropolitan University Research Ethics Committee. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutions.

## Author contributions

HN: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing.

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## Conflict of interest

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

## Publisher's note



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