Tracking the development in second language writers' use of academic vocabulary in discipline-specific assignments

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ABSTRACT

Few longitudinal studies have examined the development of second language (L2) writers' use of academic vocabulary in discipline-specific assignments. This study tracked the use of expert vocabulary and proficient novice vocabulary in assignments written by 230 L2 writers across two semesters of postgraduate study in Education and Engineering programs. Gardner and Davies's (2014) Academic Vocabulary List (AVL) and Malmström et al.'s (2018) Productive Academic Vocabulary List (PAVL) were used to represent each kind of academic vocabulary respectively. Linear mixed-effects model analyses found that Education students used significantly more AVL words in Semester 2 than in Semester 1, but no significant differences were found in the case of Engineering. This indicates that Education students tend to use more expert vocabulary as they progress further in their academic study, but Engineering students did not. Students' use of proficient novice vocabulary does not appear to change across semesters in either discipline. Analysis of the writing of individual students largely supports the findings of the group analysis, but also revealed that lexical development patterns varied depending on individuals. Together these findings demonstrate the complex nature of vocabulary development.

1. Introduction

Academic vocabulary is a set of lexical items that occur frequently in academic texts produced by expert writers/speakers (expert vocabulary) (e.g., Dang et al., 2017; Gardner & Davies, 2014) or by proficient novice writers/speakers (proficient novice vocabulary) (e.g., Malmström et al., 2018). Being able to use academic vocabulary enables students to communicate academic ideas effectively and is essential for their success in academic studies and careers (Coxhead, 2016). However, using academic vocabulary in writing can be challenging for students, especially second language (L2) learners, for several reasons. First, a reasonable number of academic words are not frequent in everyday language and may be unknown to students before their academic study (Coxhead, 2000). Second, even if students know these words receptively, it is not necessary that they use them in their writing. L2 learners' productive vocabulary knowledge often lags behind their receptive vocabulary knowledge (e.g., González-Fernández & Schmitt, 2020), and learners tend to be reluctant to produce academic vocabulary in their writing (e.g., Coxhead, 2011). Therefore, tracking the development of L2 learners' use of academic vocabulary in their academic study can provide useful insights into their language progression in the transition from novice writers to expert writers and inform the planning of language programs to support L2 learners throughout this process.

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Despite this value, to the best of our knowledge, no longitudinal studies have been conducted to track the development in L2 learners' use of both expert vocabulary and proficient novice vocabulary in discipline-specific assignments. In fact, studies employing a longitudinal research design have mainly focused on the use of academic words in essays about general topics (e.g., Zaytseva et al., 2021) while the only study that has investigated students' use of academic words in discipline-specific assignments is a cross-sectional study (Durrant, 2016). Moreover, these studies conflate academic vocabulary with expert vocabulary (i.e., the vocabulary occurs frequently in texts produced by expert writers; Gardner & Davies, 2014). However, academic vocabulary can also be proficient novice vocabulary (i.e., the vocabulary produced by university students in high-quality assignments; Malmström et al., 2018).

To address these gaps, the present study tracks development in the use of both expert vocabulary and proficient novice vocabulary in discipline-specific assignments written by international postgraduate students at a major university in the UK. The study is valuable in several ways. First, examining L2 writers' use of both expert vocabulary and proficient novice vocabulary could provide insights into their language progression in two major stages of transition from novice writers to expert writers: writing as proficient novice writers and writing as experts. Proficient novice vocabulary represents the vocabulary produced by students in high-quality assignments and is important for students on degree courses to meet their immediate academic goal (i.e., being successful in assessed assignments in these courses). Meanwhile, expert vocabulary represents the vocabulary produced by expert writers in published works, and therefore is the ultimate vocabulary goal necessary for an academic career (e.g., writing for publication). Students on degree courses, who are in the transition from novice writers to expert writers, should aim to use as much expert vocabulary in their writing as possible. Despite the value of investigating L2 writers' use of both expert vocabulary and proficient novice vocabulary, no studies have explored this area.

Another value of this study is its longitudinal research design, which would allow us to obtain in-depth information about L2 writers' development of academic vocabulary. L2 vocabulary development is an incremental process (Schmitt & Schmitt, 2020). It can be better captured by a longitudinal study (i.e., collecting data from the same participants at multiple different times) than a cross-sessional study (i.e., collecting data from the same participants at a single point in time); yet longitudinal vocabulary studies are limited in number (Pellicer-Sánchez, 2019).

The third reason why this study is useful is its focus on discipline-specific assignments, and thus would better capture L2 writers' use of academic vocabulary. Compared to essays about general topics, discipline-specific assignments better reflect the writing tasks students need to complete in their academic study. Moreover, they offer L2 writers better opportunities to use academic vocabulary because writers tend to produce more academic words in academic texts than non-academic texts (Coxhead, 2000).

Taken together, as the first study tracking the development of L2 writers' use of expert and proficient novice vocabulary in discipline-specific assignments, this study can potentially provide new insights into the growth of L2 writers' productive knowledge of academic vocabulary. Its results can inform plans for supporting students' language progression at different stages in the transition from novice writers to expert writers.

2. Background

2.1. Academic vocabulary in university writing

Academic vocabulary is often defined as expert vocabulary; that is, a set of words that occurs frequently in texts produced by expert writers such as the University Word List (Xue & Nation, 1984), the Academic Word List (AWL) (Coxhead, 2000), or the Academic Vocabulary List (AVL) (Gardner & Davies, 2014). Investigating the use of expert vocabulary in students' writing is useful because it indicates how close students are to achieving the ultimate vocabulary goals necessary for an academic career (e.g., writing for publication). However, Nesi et al. (2004, p.440, cited in Paquot, 2010) points out that students' more immediate goal is to write assessed texts in their university courses. Therefore, several attempts (Malmström et al., 2018; Paquot, 2010) have been made to identify sets of proficient novice vocabulary (i.e., the vocabulary occurring frequently in university students' high-quality assignments) and compare them with sets of expert vocabulary. These studies found that proficient novice writers use expert vocabulary in their writing to some degree, but there is a certain distinction between expert vocabulary and proficient novice vocabulary.

One question that arises is to what extent students' use of each kind of vocabulary changes throughout their university study. To the best of our knowledge, only Durrant (2016) has addressed this question to some extent. As part of a study with the primary purpose of checking the validity of Gardner and Davies's (2014) AVL, a list of expert vocabulary, Durrant analyzed occurrences of AVL words in the British Academic Written English Corpus (BAWE). This corpus was derived from merit and distinction assignments written by proficient undergraduate and taught postgraduate students from 30 disciplines. He found that students' use of AVL words in these scripts increased significantly from 1st year undergraduate to postgraduate levels. Moreover, as a whole the AVL words accounted for an average of 16.82 % of the total number of words in the scripts from the BAWE corpus, and the AVL lexical words for an average of 33.82 % of the lexical words. These findings suggest that the further students progress through their academic study, the more expert vocabulary they are likely to use, and that expert vocabulary accounts for a reasonable percentage of words in novice writing.

Although Durrant's primary purpose is to validate the AVL rather than track vocabulary development, his study provides useful insights into the use of expert vocabulary in novice writing from the perspective of a cross-sessional research design. However, as the development of vocabulary knowledge is incremental (Schmitt & Schmitt, 2020), a longitudinal study would enable researchers to better track students' vocabulary development (Pellicer-Sánchez, 2019). Moreover, Durrant only examined expert vocabulary, while knowledge of proficient novice vocabulary is also necessary for students to write high-quality assessed assignments as part of their degree courses. Also, his findings were based on the analysis of merit and distinction assignments written by both English L1 and L2 students. It is unclear whether these findings hold true in assignments that are (a) awarded at lower grades (fail and pass) and (b) written by L2 writers alone. Expanding on Durrant's study, the present study employs a longitudinal research design to examine use of

both expert and proficient novice vocabulary in assignments of different quality produced by only L2 writers.

2.2. Longitudinal research on academic vocabulary in writing

A number of longitudinal studies have been conducted to track L2 writers' use of academic vocabulary in writing. Several studies reported an increase in students' use of academic vocabulary over time. Laufer (1991) and Zheng (2016) conducted studies with EFL university students in Israel and China, respectively. In both studies, each student wrote two argumentative essays on the same topic: one at the beginning of their one-year university course and another at the end of the course. Laufer used Xue and Nation's (1984) University Word List to represent academic words while Zheng (2016) used the words outside the most frequent 2000 words of general English. Despite the different measures, both studies found that their participants' use of academic words increased over the academic year.

Storch and Tapper (2009) and Mazgutova and Kormos (2015) conducted studies with students in EAP courses at universities in Australia and the UK, respectively. In both studies, the participants wrote argumentative essays of the same topics at the beginning and at the end of their courses, and Coxhead's (2000) AWL was used to represent academic vocabulary. Similar to previous studies, Storch and Tapper (2009) and Mazgutova and Kormos (2015) found their participants' use of academic vocabulary increased over the EAP courses.

Olsson (2021) carried out a study with secondary school students in CLIL programs in Sweden. The students were asked to write four argumentative texts in English over their three-year study at secondary schools. Unlike previous studies, Olsson (2021) used the AVL (Gardner & Davies, 2014) to represent academic words. Their analysis found that the participants' use of academic words increased across their study.

However, not all longitudinal research on academic vocabulary has found significant increase in participants' use of academic words. Deng et al. (2010) conducted a study with EAP students at a university in Singapore, Knoch et al. (2015) carried out a study with undergraduate international students at a university in Australia, and Zaytseva et al. (2021) conducted a study with EFL undergraduate students in Spain who took a three-month study abroad course in an English-speaking country. Again, participants in these studies were asked to write argumentative essays on the same topic at the beginning and at the end of their programs. The AWL was used to represent academic words. None of these studies found their participants' use of academic words significantly changed across their period of study.

Taken together, the findings of previous longitudinal studies are fairly mixed. While some studies found significant increase in L2 writers' use of academic words, the others did not. The conflicting findings could be explained in several ways. First, most of these studies examined the use of academic words in essays on general topics. General topics tend to generate the use of non-academic words. In contrast, academic texts are likely to generate the use of academic words. Therefore, investigating students' use of academic words in discipline-specific assignments would provide better insights into their development in academic vocabulary use. Second, earlier studies only examined the growth in the use of expert vocabulary, represented by the AVL, the AWL, or the UWL. It would be useful to examine students' use of proficiency novice vocabulary as well. Knowledge of this vocabulary is important for students to achieve their immediate goal (i.e., writing assessed assignments in their degree courses), and appears to be a more achievable goal for L2 learners than expert vocabulary. Last but not least, the conflicting findings of previous studies suggest that more evidence with L2 writers in other contexts is needed to advance our understanding of L2 academic vocabulary development. Previous studies have mainly focused on L2 writers in the EFL contexts, the study abroad context, EAP courses, and CLIL contexts. The only study with L2 writers on degree courses (Knoch et al., 2015) examined the use of academic words in essays on general topics rather than on discipline-specific assignments. It would be useful to look at L2 writers on degree courses and the use of academic vocabulary in discipline-specific assignments.

2.3. Research questions

The literature review has shown that despite their value, no longitudinal studies have examined development in expert and proficient novice vocabulary use in discipline-specific assignments produced by L2 writers on degree courses. To address this gap, this study tracks the use of these two kinds of academic vocabulary in discipline-specific assignments produced by L2 writers on one-year postgraduate degree programs. It is valuable to track the vocabulary development of L2 writers. Unlike native speakers of English, this group of students have to learn discipline-specific subjects in an L2 and may likely need different kinds of support in their transition into studying in English-medium university courses. It is worth focusing on L2 postgraduate students because this group of learners make up a significant proportion of students on degree courses in English-speaking countries. In particular, the current study will address the following research questions:

1. To what extent does L2 writers' use of expert vocabulary in assessed discipline-specific assignments change over their postgraduate degree study?
2. To what extent does these students' use of proficient novice vocabulary in these assignments change over this period of study?

3. Methodology

3.1. Corpora construction

Two corpora were created from assessed discipline-specific assignments from 25 modules[1] written by 230 Education and Engineering international students[2] at a major university in the UK. This university was chosen because it is among the UK universities with the highest number of international postgraduate students (Study in the UK, n.d.). Moreover, the postgraduate programs in the chosen university share features with postgraduate programs in other British universities. To be accepted onto these programs, international students have to meet language entry requirements (IELTS of at least 6.5 overall or equivalent), and those who do not meet the minimum language requirements have to attend pre-sessional language courses before joining their destination programs[3]. The postgraduate program lasts for one academic year, which consists of two semesters. In the first semester, students study core modules which provide them with a solid background knowledge of their discipline. In the second semester, they take optional modules to deepen their knowledge of disciplinary areas of interest and then complete a small-scale research project related to these areas.

Education and Engineering were chosen as the sampled disciplines for several reasons. First, they are among the disciplines that attract the largest number of international students in the UK (Study in the UK, n.d.). Second, these two disciplines represent soft and hard sciences, respectively. Previous research (Becher, 1989; Biglan, 1973a; Biglan, 1973b) has shown that the hard/soft division is the strongest dimension distinguishing academic subjects in higher education. This dimension has been used to guide the structure of well-known academic corpora such as the BAWE corpus and the British Academic Spoken Corpus (BASE). Third, as part of a larger scale project funded by the British Council and IELTS, we conducted focus-group interviews with content lecturers and students from Education and Engineering and analyzed the assignment marking criteria of these disciplines. The findings indicate that there are differences in the assessments of the two disciplines. The assessments in Education are more essay-based. In contrast, those in Engineering are more test-based, but students also need to write final year project reports. Moreover, the marking criteria in Education did not focus on specific linguistic features (e.g., vocabulary use, grammar, punctuation), but those in Engineering did. As students in the two disciplines have different experiences with academic writing, comparing assignments written by Education and Engineering students would provide further insights into the variations in students' use of expert vocabulary and proficient novice vocabulary across disciplines.

The data collection was conducted from August 2021 to November 2022. Each student was invited to submit two assignments: one from Semester 1 and another from Semester 2. After getting consent from the content lecturers and students, we manually downloaded the PDFs of the assignments from the university virtual learning platform. After the PDFs of the assignments had been downloaded, they were coded and converted to text files with the ABBYY PDF Transformer+ program so that they could be analyzed with corpus programs later. Information that was not relevant to the analysis (e.g., students' names and ID, cover sheets, references, appendices, figures, tables, and mathematic formulae) were removed from the texts. This process also helped to anonymize the data. The texts were further cleaned up following Nation and Webb's (2011) guidelines. Tables 1 and 2 present detailed information about the corpora.

3.2. Data analysis

This study examined participants' use of expert vocabulary and novice vocabulary in their assignments. Expert vocabulary and proficient novice vocabulary were represented by the AVL (Gardner & Davies, 2014) and the PAVL (Malmström et al., 2018), respectively. The AVL was created from the academic section of the Corpus of Contemporary American English (COCA), which consists of academic journal articles, newspapers, and magazines (120 million words). The AVL words needed to satisfy certain criteria related to frequency, range, and dispersion to ensure that they represent the words used frequently by a large number of expert writers. The validity of the AVL as an academic word list is supported by its higher lexical coverage in the academic texts than in non-academic texts. The PAVL was developed from the BAWE corpus (6.5 million words). This corpus was derived from merit and distinction assignments written by proficient undergraduate and taught postgraduate students from 30 disciplines. The PAVL was developed following the same selection criteria as the AVL and it was found that a substantial number of PAVL words (64.64 %) also appear in the AWL.

The AVL was chosen because of its innovative method of identifying expert vocabulary. This list was created from scratch rather than on the top of a general high-frequency word list. Therefore, unlike earlier lists of expert vocabulary (e.g., the AWL), the AVL was not affected by the age of the high-frequency word baseline. Moreover, the AVL was used by Durrant (2016) to investigate differences in the use of academic vocabulary in assignments written by students at different university levels. The PAVL was chosen because to the best of our knowledge, it is the only available list representing academic vocabulary produced by proficient novice writers. Also, the development of this list followed the same principles of the AVL, which makes it straightforward to compare the results of the analyses

Table 1
Number of students and scripts in the corpus.

Discipline	Number of students	Number of scripts	Size (words)	Mean length	Min length	Max length
Education	116	232	806,604	3477	1329	12,878
Engineering	114	228	918,875	4030	801	8725
Total	230	460	1725,479	3751	801	12,878

Table 2

Number of scripts in each assignment grade band.

Grade band	Grade	Education	Engineering	Total
Fail	Below 50	8	6	14
Pass	50–59	75	62	137
Merit	60–69	96	112	208
Distinction	70 and above	53	48	101
Total		232	228	460

of expert and proficient novice vocabulary.

In their original form, the AVL is a lemma list and the PAVL is a word type list. For consistency, we converted the AVL lemmas into word types so that the AVL used in our study has the same lexical unit as the PAVL. The word type was chosen because it is likely to be more relevant as a lexical unit of productive vocabulary than the lemma (Malmström et al., 2018; Nation, 2016).

For each group of words, as well as analysing function words and lexical words together, we conducted separate analyses for lexical words because they usually hold the key meaning of the texts and are essential for vocabulary study (Durrant, 2016). Items that are outside Nation's (2016) list of function words and Nation's (2012) lists of proper nouns and marginal words were considered as lexical words. The raw frequency of items from relevant lists in each script in the two corpora was counted with the RANGE program (Heatley et al., 2002), and the lists of these items were set as the base word lists. To deal with the variation in the script length, for each word we normed its raw frequency in the script by dividing it by the total number of running words in the script and multiplying by 100.

To answer the research questions, we performed four separate linear mixed-effects models with the lme4 package in the R platform (Version 4.1.1/2021–08–10). The purpose of these models was to test the effect of time (semester) on the participants' use of expert vocabulary and proficient novice vocabulary in their assignments. The dependent variable in each model was as follows.

- the normed frequency of each of the AVL lexical and function words (Model 1)
- the normed frequency of each of the lexical AVL words (Model 2)
- the normed frequency of each of the PAVL as a whole (Model 3)
- the normed frequency of each of the lexical PAVL words (Model 4)

In each model, Participant was set as a random effect to control the impact of individual differences on the use of academic words. The primary purpose of our study is to examine the change in the use of academic words across semesters, not across genres or topics. However, assignment genres and topics may affect participants' use of vocabulary. To control the variation in vocabulary use due to genre or topic differences, we have added Genre and Module code as random factors in our model. To identify the genre of each assignment, we looked closely at the assignment briefs, where module leaders specified the assignment requirements. Based on this information, we identified the genre of each assignment according to Nesi and Gardner's (2012) classification of genre families. As for assignment topics, in our context, each module has one assignment which focuses on a distinctive topic. Setting Module code as a random factor would allow us to control the effects of assignment topic and other module-related factors that we are not aware of. Assignment genre, Time (semester 1, semester 2), Discipline (Education, Engineering), and their interactions were fixed effects. Because Time and Discipline were categorical factors, treatment coding was used when coding these variables. Semester 1 was coded as the reference level for Time. Education was first coded as the reference level for Discipline to directly examine the changes of Education students. Then, to directly examine the changes of Engineering students, we releveled the models with Engineering serving as the baseline for Discipline. Following one reviewer's suggestions, we also set Assignment Grade and IELTS score as fixed effects. The deadline for all students to submit their Semester 1 assignments was January, which was the end of Semester 1, and Semester 2 assignments was May, which was the end of Semester 2. The exact submission dates within the same semester varied according to module but this variation was very small. For example, submission deadlines for Semester 1 modules were 16th and 23rd January while those for Semester 2 modules were 21st, 23rd, and 30th May. Given the considerable gap between the submission deadlines of the two semesters and the slight variation in the submission deadlines of modules within the same semester, the variation in assignment submission intervals would be unlikely significantly affect the comparison of the use of academic words across semester. However, to control the effect of the variation in assignment submission intervals, the duration between the submission deadlines of the Semester 1 and Semester 2 assignment submitted by each student was also added as another fixed effect. To further investigate the interaction between Time and Disciplines, we ran a series of pairwise comparison tests with the emmeans package with Bonferroni adjustments for multiple comparisons.

The linear mixed-effects model provides useful information about the change in the participants' use of academic vocabulary as a group. In addition to the group analysis, we also examined changes in the vocabulary use of individual students. First, we calculated the difference in the normed frequency of the AVL and PAVL words in assignments written by each student in Semester 1 and Semester 2. Then, we classified each student into groups based on three patterns: (a) those with increasing use (i.e., the normed frequency of AVL/PAVL words in the student's Semester 2 assignment was higher than that in their Semester 1 assignment), (b) those with unchanged use (i.e., the normed frequency of AVL/PAVL words in the student's Semester 2 assignment was between 0 % and 10 % lower than that in their Semester 1 assignment), and (c) those with decreasing use (i.e., the normed frequency of AVL/PAVL words in the student's Semester 2 assignment was 10 % or more lower than that in their Semester 1 assignment).

4. Results

4.1. Linear mixed effects models analysis

Appendix 1 presents descriptive information about the participants' use of the AVL words. When all participants were considered together, on average they used more AVL lexical and function words combined and AVL lexical words alone in Semester 2 than in Semester 1. When students from each discipline were examined, the use of AVL lexical and function words combined and AVL lexical words alone increased from Semester 1 to Semester 2 in the case of Education students, but slightly decreased in the case of Engineering students. To determine whether these differences were significant or not, we ran two linear mixed-effects (Models 1 and 2) which examined the effects of time, discipline, their interaction, assignment grade, IELTS score, and variation in assignment submission intervals on the participants' use of AVL lexical and function words combined (Model 1) and AVL lexical words only (Model 2).

The whole Model 1 (both fixed and random effects) explained 56 % of the variance in participants' use of AVL function and lexical words combined (conditional $R^2 = 0.56$) and the fixed effects explained 15 % (marginal $R^2 = 0.15$)[4]. The whole Model 2 explained 57 % of the variance on the participants' use of AVL lexical words (conditional $R^2 = 0.57$) and the fixed effects explained 15 % (marginal $R^2 = 0.15$). Information about the random effects of these modules is presented in Appendices 2 and 3.

Tables 3 and 4 present the results of Models 1 and 2 related to the fixed effects. Time had a significant main effect on the baseline group's use of both AVL words ($p = 0.02$) and lexical AVL words ($p = 0.03$). As Education was set as the baseline group in these models, it means that the main effect of Time (semester) reflects the change in the use of AVL words and lexical AVL words for Education students only. When Models 1 and 2 were releveled with Engineering serving as the baseline, Time had no significant effect on the baseline group's use of AVL words ($p = 0.89$) nor lexical AVL words ($p = 0.81$). It means that Time (semester) does not have a main effect on Engineering students' use of AVL words nor lexical AVL words.

Whether Education or Engineering was set as the baseline, the interaction between Time and Discipline had no significant effects (both p values > 0.05). The marginal means obtained from the analysis with the emmeans package indicated an increase in the use of AVL words from Semester 1 to Semester 2 for both Education (from 21.8 to 23.4) and Engineering (from 23.4 to 23.6). Similarly, the use of lexical AVL words increased across semesters for both Education (from 21.2 to 22.7) and Engineering (from 22.7 to 23.1). However, pairwise comparisons showed that the difference in the change between Semester 1 and Semester 2 was not significantly different for Engineering compared to Education students (all p values > 0.05).

Taken together, these findings indicate that in terms of within-group change, Education students significantly used more AVL words and lexical AVL words in Semester 2 than Semester 1. Engineering students also used slightly more AVL words and lexical AVL words in Semester 2 than in Semester 1, but this difference was not statistically different. In terms of between-group differences in trends, the rate of changes in the use of AVL words and lexical words across semester was not significantly different between two disciplines although Education students experienced significant within-group increases. In both Models 1 and 2, Assignment grade, IELTS scores, and variation in assignment submission intervals did not have any significant association with the use of AVL words nor AVL lexical words (all $p > .05$). The insignificant effect of the variation in assignment submission intervals found in the present study means that the variation in the submission intervals of individual students made no significant differences in the students' uses of expert vocabulary. For example, the use of expert vocabulary of a student who submitted their Semester 1 assignment on 23rd January and their Semester 2 assignment on 23rd May was not significantly different from that of another student who submitted their Semester 1 assignment on 16th January and their Semester 2 assignment on 21st May.

Appendix 4 presents descriptive information about the participants' use of the PAVL words. Whether students from both disciplines combined or each discipline were considered, their use of PAVL words and PAVL lexical words decreased from Semester 1 to Semester 2. To examine whether these differences were significant or not, we ran another two linear mixed-effects models (Models 3 and 4), which examined the effects of Time, Discipline, their interaction, assignment grade, IELTS score, and variation in assignment submission intervals on the participants' use of PAVL words (Model 3) and PAVL lexical words (Model 4).

The whole Model 3 explained 71 % of the variance on the participants' use of PAVL function and lexical words combined (conditional $R^2 = 0.71$), but the fixed effects explained only 5 % (marginal $R^2 = 0.05$). Likewise, the whole Model 4 explained 74 % of the variance on the participants' use of PAVL lexical words (conditional $R^2 = 0.74$) and the fixed effects explained only 6 % (marginal $R^2 = 0.06$). Information of the random effects of these modules is presented in Appendices 5 and 6.

Tables 5 and 6 show that when Education was set as the baseline, Time did not have a significant main effect on the use of PAVL words ($p = 0.59$) nor the use of lexical PAVL words ($p = 0.98$). Similarly, when Models 3 and 4 were relevelled with Engineering as the

Table 3

Effects of Time, Discipline, their interaction, Assignment grade, IELT scores, and variation in assignment submission intervals on the participants' use of AVL lexical and function words combined (Model 1- Education and Semester 1 as the baseline).

	b	SE	95 % CI	df	t	p
(Intercept)	19.66	2.49	[14.78, 24.54]	153.78	7.89	< 0.001
Time	1.58	0.65	[0.30, 2.86]	24.15	2.42	0.02
Discipline	2.88	2.09	[−1.21, 6.98]	3.43	1.38	0.25
Time: Discipline	−1.36	1.31	[−3.92, 1.20]	0.99	−1.04	0.49
Assignment grade	0.03	0.02	[−0.01, 0.06]	362.01	1.52	0.13
IELTS score	−0.31	0.31	[−0.92, 0.30]	198.13	−1.0	0.32
Variation in assignment submission intervals	0.32	0.28	[−0.23, 0.87]	212.07	1.13	0.26

Table 4
Effects of Time, Discipline, their interaction, Assignment grade, IELT score, and variation in assignment submission intervals on the participants' use of lexical AVL words (Model 2- Education and Semester 1 as the baseline).

	b	SE	95 % CI	df	t	p
(Intercept)	19.22	2.51	[14.30, 24.13]	154.75	7.66	< 0.001
Time	1.53	0.65	[0.25, 2.81]	20.89	2.34	0.03
Discipline	2.59	2.18	[−1.69, 6.87]	4.81	1.19	0.29
Time: Discipline	−1.12	1.42	[−3.90, 1.66]	1.41	−0.79	0.54
Assignment grade	0.02	0.02	[−0.01, 0.06]	362.22	1.31	0.19
IELTS score	−0.29	0.31	[−0.90, 0.32]	197.99	−0.94	0.35
Variation in assignment submission intervals	0.32	0.28	[−0.23, 0.88]	212.08	1.15	0.25

Table 5
Effects of Time, Discipline, their interaction, Assignment grade, IELTS score, and variation in submission intervals on the participants' use of PAVL lexical and function words combined (Model 3- Education and Semester 1 as the baseline).

	b	SE	95 % CI	df	t	p
(Intercept)	12.14	1.51	[9.18, 15.11]	115.81	8.03	< 0.001
Time	−0.24	0.44	[−1.11, 0.63]	30.91	−0.54	0.59
Discipline	0.83	1.68	[−2.46, 4.12]	6.23	0.49	0.64
Time: Discipline	−0.87	1.12	[−3.06, 1.32]	2.14	−0.78	0.51
Assignment grade	0.02	0.01	[0.001, 0.04]	347.18	2.11	0.04
IELTS score	−0.13	0.18	[−0.49, 0.22]	195.91	−0.73	0.47
Variation in assignment submission intervals	0.12	0.22	[−0.31, 0.55]	223.36	0.54	0.59

Table 6
Effects of Time, Discipline, their interaction, Assignment grade, IELT score, variation in assignment submission intervals on the participants' use of lexical PAVL words (Model 4- Education and Semester 1 as the baseline).

	b	SE	95 % CI	df	t	p
(Intercept)	9.77	1.29	[7.25, 2.28]	52.19	7.60	< 0.001
Time	0.01	0.45	[−0.87, 0.89]	45.44	0.02	0.98
Discipline	1.68	1.93	[−2.10, 5.46]	6.63	0.87	0.42
Time: Discipline	−1.23	1.34	[−3.86, 1.39]	2.47	−0.92	0.44
Assignment grade	0.02	0.01	[0.001, 0.03]	349.48	2.10	0.04
IELTS score	−0.27	0.13	[−0.53; −0.01]	189.53	−2.07	0.04
Variation in assignment submission intervals	0.09	0.16	[−0.24, 0.41]	222.50	0.52	0.60

baseline, no significant effect of Time was found on the use of PAVL words ($p = 0.42$) nor the use of lexical PAVL words ($p = 0.44$). Regardless of the baseline, the interaction between Time and Discipline had no significant effect (all p values > 0.05). The marginal means showed slight decreases from Semester 1 to Semester 2 in the use of PAVL words (from 12.3 to 12.1 for Education and from 12.3 to 11.2 for Engineering) while the use of lexical PAVL words slightly increased from 8.97 to 8.98 for Education and decreased from 9.41 to 8.19 for Engineering. Pairwise comparison indicated that the difference in the change between Semester 1 and Semester 2 was not significantly different for Engineering compared to Education students (all p values > 0.05). Taken together, these findings indicate that in terms of within-group change, regardless of discipline, the participants' use of the PAVL words did not significantly change across semesters. In terms of between-group difference in trends, the rate of changes in the use of PAVL words and lexical PAVL words across semesters was not significantly different between Education and Engineering.

In both Models 3 and 4, variation in assignment submission intervals did not significantly associate with the participants' use of PAVL words nor lexical PAVL words (all p values >.05). However, assignment grade did ($p < .05$), which indicates that the higher the assignment grade, the more PAVL words were used. IELTS scores were not significantly associated with the use of PAVL words ($p = 0.47$), but had a significant, negative relation with the use of lexical PAVL words ($p = 0.04$).

Table 7
Percentage of students within each pattern for AVL words (%).

Types of words	Lexical & function words combined			Lexical words		
	Decreasing	Unchanged	Increasing	Decreasing	Unchanged	Increasing
Both disciplines	17.83	26.09	56.09	12.17	23.91	63.91
Education	12.93	14.66	72.41	5.17	6.90	87.93
Engineering	21.05	39.47	39.47	19.30	41.23	39.47

4.2. Patterns of lexical development among individual students

Tables 7 and 8 summarizes the lexical development patterns of individual students. Regardless of the kinds of academic vocabulary and disciplines, there were students with increasing use, those with unchanged use, and those decreasing uses.

Table 7 shows that in the case of AVL words, similar patterns were found for both Engineering combined Education and Education alone. Students belonging to the *increasing* group accounted for the largest percentage of the participants in the case of Education and Engineering combined (56.09 % and 63.91 %) and Education alone (72.41 % and 87.93 %). It is followed by those from the unchanged group: 26.09 % and 23.91 % (for both disciplines) and 14.66 % and 6.90 % (for Education only). Students from the *decreasing* group also made up the smallest percentage: 17.83 % and 12.17 % (for both disciplines) and 12.93 % and 5.17 % (for Education only). However, in the case of Engineering students, students from the *increasing* group and the *unchanged* group made up a fairly similar percentage (around 40 %) while those from the *decreasing* group made up a lower percentage (around 20 %).

Table 8 presents the patterns related to the PAVL words. Irrespective of the disciplines, the percentage of participants from the *increasing* group, *unchanged* group, and *decreasing* group was relatively similar (from 20 % to 40 %).

5. Discussion

This study is the first longitudinal study that has tracked L2 learners' use of both expert vocabulary and proficient novice vocabulary. It is also among the few studies that have examined the use of academic vocabulary in discipline-specific assignments produced by L2 writers on degree courses. Therefore, it provides further insights into L2 writers' language progression in the transition from novice writers to expert writers.

5.1. The nature of L2 academic vocabulary development

In answer to the first research question, the group analyses found that regardless of whether function words and lexical words combined or lexical words alone were examined, Education students used significantly more AVL words in Semester 2 than in Semester 1 while Engineering students' use of AVL words did not significantly change across semesters. These findings indicate that students' use of expert vocabulary is likely to increase as they progress further in their postgraduate studies in the case of Education students, but it does not seem to be the case for Engineering students. The results of the group analyses were largely supported by the results of the individual analyses. In the case of Education, students from the *increasing* group made up the largest percentage (72.41 % and 87.93 %) while the percentages of the *unchanged* group (14.66 % and 6.90 %) and *decreasing* group (12.93 % and 5.17 %) were small. In contrast, in the case of Engineering, the percentages of students from the *increasing* group and the *unchanged* group were similar (around 40 %) and only slightly higher than those from the *decreasing* group (around 20 %).

The Education students' increasing use of expert vocabulary could be the result of the cumulative amount of exposure to expert vocabulary in their postgraduate study. For incidental vocabulary learning to occur, learners need to encounter and use target vocabulary repeatedly in various contexts (Webb & Nation, 2017). Throughout their program, the participants had multiple opportunities to expose themselves to expert vocabulary in meaningful ways (e.g., reading academic texts, listening to academic lectures, feedback on their assignment drafts, group discussion and in-sessional language support for their academic writing). Earlier studies have found that L2 learners can incidentally pick up expert vocabulary from academic lectures (Dang et al., 2022; Vidal, 2003) and academic texts (Vidal, 2011), and that feedback on writing can help to improve L2 vocabulary acquisition (Nakata, 2015). Therefore, although expert vocabulary was not explicitly instructed, the participants may have gradually picked up and incidentally learned these words as they progressed further in their postgraduate study.

This study found that the increase in the proportion of AVL words per assignment written by Education students was about 2 %. Readers may think that this gain is small. However, this gain is meaningful for several reasons. First, it is larger than the gain found by Knoch et al. (2015) (0.45 %), the only previous longitudinal study with L2 writers on degree courses. One possible reason for this larger gain is that unlike Knoch et al., we examined discipline-specific assignments rather than essays on general topics, and thus could better capture L2 writers' use of academic words. Second, while the gain looks small, it reflects the incremental nature of vocabulary development, especially productive vocabulary development. L2 learners' productive vocabulary knowledge often lags behind their receptive vocabulary knowledge (e.g., González-Fernández & Schmitt, 2020), and learners tend to be reluctant to produce academic vocabulary in their writing (e.g., Coxhead, 2011). Therefore, the gain found in our study, though small but significant, is an encouraging result.

Unlike Education students, no significant changes were seen in the case of Engineering students. One possible reason for the insignificant change in the use of expert vocabulary by Engineering students is that they already used a reasonable number of expert

Table 8
Percentage of students within each pattern for PAVL words (%).

Types of words	Lexical & function words combined			Lexical words		
	Decreasing	Unchanged	Increasing	Decreasing	Unchanged	Increasing
Both disciplines	28.70	36.96	34.35	28.70	31.74	39.57
Education	37.07	33.62	29.31	37.07	25.00	37.93
Engineering	20.18	40.35	39.47	20.18	38.60	41.23

words in Semester 1. Although these students may have incidentally learned new vocabulary during their postgraduate study, incidental learning is an incremental process, and it takes time for significant gains to be evident (Webb, 2020). Compared to Education students, Engineering students knew a larger number of expert words in Semester 1, and thus may have less room to make significant improvement in Semester 2.

The Education students' increasing use of expert vocabulary across semesters suggests that studying in English-medium degree courses helps students to approach expert level in terms of vocabulary use. This is encouraging because being able to use expert vocabulary in writing is the ultimate goal of university students if they would like to follow academic careers (Gardner & Davies, 2016). It also indicates that while writing is the final product of university study, exposure to expert vocabulary through other modes (academic reading, listening, and speaking) could potentially enable students to pick up these words incidentally. However, the insignificant change in Engineering students' use of expert vocabulary indicates that it may take time for significant improvements to be evident and various factors (e.g., students' prior vocabulary knowledge) may affect the improvement.

In answer to the second research question, the group analyses showed that regardless of the discipline and whether function words and lexical words combined or lexical words alone were investigated, the participants' use of the PAVL words was not significantly different between the two semesters. These findings are supported by those from the individual analysis, which showed that the percentage of students from the *increasing* group, *decreasing* groups, and *unchanged* group was relatively similar. Together these findings suggest that students' use of proficient novice vocabulary is unlikely to change during their postgraduate study. Being able to use proficient novice vocabulary is an immediate vocabulary goal for university students (Nesi et al., 2004). Yet no previous studies have examined changes in students' use of this kind of vocabulary in their academic study. Therefore, the present study made a useful contribution to existing literature.

The participants' insignificant change in the use of proficient novice vocabulary across semesters could be explained in several ways. To begin with, we conducted further analysis and found that 74.41 % of the PAVL words and 57.82 % of the AVL words are high-frequency words in general English. As the participants had already met the language entry requirements to be accepted to their postgraduate programs, they were likely to have had a solid knowledge of general high-frequency words and may already have known and used these PAVL and AVL words. Considering the proportion of general high-frequency words in the two lists, we can see that the PAVL has fewer items that are outside general high-frequency words (25.59 %) than the AVL (42.18 %). It means that there was less room for the participants to learn novel words in the case of the PAVL than the AVL, which could explain why no significant changes were seen for PAVL words.

Another possible reason for the participants' insignificant change in the use of proficient novice vocabulary across semesters is their limited exposure to texts written by proficient novice writers. To familiarize students with academic conventions and assignment requirements, module lecturers in the examined programs provided students with sample assignments written by former students. However, due to concerns of plagiarism, students were warned to avoid using language similar to that in sample assignments. Moreover, the number of samples was just one or two samples per modules, and some lecturers did not provide sample assignments or just provided extracts of these assignments. This modest exposure to proficient novice writing may lead to a small chance for incidental learning of proficient novice vocabulary.

This study found that Education students used significantly more expert vocabulary in Semester 2 than in Semester 1, but no significant changes were seen for Engineering students. In the meantime, for both groups, students' use of proficiency novice vocabulary did not change significantly across semesters. Moreover, regardless of the kinds of academic vocabulary being examined, the rates of changes across semesters were not significantly different across disciplines. The similarities and differences between the vocabulary used by Education and Engineering students in the present study support Durrant's (2016) observation that texts written by students from different academic disciplines contained a certain amount of shared expert vocabulary but also had certain variations in vocabulary use across disciplines. Expanding on Durrant (2016), this study found in the case of proficient novice vocabulary, the difference across disciplines seems to be lesser because neither disciplines made significant changes in the use of proficient novice vocabulary across semesters. This finding could be because participants from both disciplinary groups were novice writers.

Together the findings of the present study provide insight into the nature of academic vocabulary development. They indicate that academic vocabulary development is not a straightforward process, and it may be slow and depends on various factors such as disciplines, kinds of academic vocabulary, and individual students. The group analysis showed that while Education students make significant improvements in the use of expert vocabulary from Semester 1 to Semester 2, Engineering students may need more time for significant changes to be evident. Meanwhile, regardless of disciplines, students use of proficient novice vocabulary did not change significantly across semesters. Additionally, although the individual analysis generally supports the trends identified in the group analyses, it also indicated that the lexical development patterns varied according to individuals. While some students used more academic vocabulary, the others did not, and some even used less. This complex nature of vocabulary development supports the Complex Dynamic Systems Theory (De Bot et al., 2007; Larsen-Freeman, 1997), which proposes that language development is not a linear, static process and cannot be captured by cross-sessional research design. It also supports Pellicer-Sánchez's (2019) call for more longitudinal studies to achieve deeper understanding of the vocabulary development and thus highlights the value of the present study.

The complex nature of L2 productive knowledge of academic vocabulary growth revealed in the study helped to explain the mixed findings of previous longitudinal studies on L2 writers' use of expert vocabulary (e.g., Mazgutova & Kormos, 2015; Zaytseva et al., 2021). It also expands on these studies in two ways. First, unlike previous studies, the present study examined vocabulary in discipline-specific assignments rather than essays about general topics. As writers use more expert words in academic texts than non-academic texts (Coxhead, 2000), this study provided a more accurate picture of L2 writers' use of academic words than earlier studies. Second, while previous studies only examined the use of expert vocabulary, the present study also examined the use of both expert vocabulary and proficient novice vocabulary. Therefore, it can provide further insights into two major stages of transition from

novice writers to expert writers: writing as proficient novice writers and writing as experts.

5.2. The value of lists of expert vocabulary

This study provides further insights into debate on the value of lists of expert vocabulary such as the AVL. Several researchers (e.g., Durrant, 2016; Malmström et al., 2018) have questioned the relevance of these lists as the productive vocabulary learning goals for L2 students. They point out that items in these lists are likely to be beyond the level of these students and propose that proficient novice vocabulary may be a more realistic goal because it relates to students' immediate needs (i.e., succeeding at their university assessment). However, Gardner and Davies (2016) argue that lists of expert vocabulary represent the ultimate vocabulary learning goals for students and that although the primary focus of these lists is receptive vocabulary knowledge, they are also useful resources for exploring students' productive vocabulary use. By finding that Education students' use of AVL words in discipline-specific assignments increased across the two semesters, the present study provides empirical evidence supporting Gardner and Davies's point. Moreover, expanding on previous research, instead of only examining the AVL, this study also examined it in relation to the PAVL. Thus, it provides further insights into the relative value of items in lists of expert vocabulary and lists of proficient novice vocabulary in investigating L2 vocabulary development.

5.3. The effects of assignment grades, IELTS scores, variation in assignment submission intervals

Despite not being the focus of the present study, several other interesting findings about the factors contributing to academic vocabulary use emerged. First, the participants' assignment grades were significantly associated with their use of PAVL words, but not their use of AVL words. It means that assignments with higher assignment grades tend to contain significantly larger proportion of proficient novice words than those with lower grades while no significant difference in the proportion of expert words in assignment of different grades. The significant relation of assignment grades on the participants' use of proficient novice words could be because the PAVL was originally developed from merit and distinction assignments written by proficient undergraduate and taught postgraduate students. This finding provides further evidence supporting the validity of the PAVL as a list of proficient novice vocabulary. The insignificant relation of assignment grades on the participants' use of expert words could be because students, even higher achievers, still have fairly limited knowledge of expert words. Second, the participants' IELTS scores had a negative, significant relation with their use of PAVL lexical words, but were not significantly associated with their use of AVL words. This finding indicates that the higher IELTS scores students had, the fewer proficient novice words they used in their discipline-specific assignment. In the meantime, IELTS scores did not seem to have a significant relation to students' use of academic words. This finding could be due to the different nature of IELTS writing and disciplinary writing. Third, the variation in assignment submission intervals did not have a significant association with the participants' use of AVL words nor PAVL words. This finding indicates that in the present study, the relation between variation in the duration of assignment submission time and the use of academic words did not seem to be as great as expected. It is important to note that the relations between assignment grades, IELTS scores, and variation in assignment submission intervals and the use of academic words were not the primary aim of the present study, and therefore, these findings should not be generalised and need further investigation.

6. Limitations & future research

The present study has some limitations. First, due to the lack of productive lists of proficient novice multiword sequences, this study only examined the development of single words. Given the importance of multiword sequences for L2 vocabulary development (Siyanova-Chanturia and Pellicer-Sánchez, 2019), future research on multiword sequences would provide further insights into the development of L2 learners' use of academic vocabulary. Second, like most vocabulary studies, the current study is quantitative. Mixed-methods research could provide deeper insights into vocabulary development (Dang et al., 2023). Third, due to the challenge of obtaining students' assessed assignments, we only sampled assignments written by Education and Engineering students. While care was taken when selecting these disciplines as the cases, future studies with students from a wider range of disciplines would be useful. Fourth, age and gender may have some impact on the participants' use of academic words. We did not collect the information about the participants' ages and genders, and thus could not test this hypothesis. Fifth, our study could only capture the words that the participants used. It could not provide direct evidence about what they know because students may know certain words, it is not necessary they use them in their writing. Last but not least, due to the challenges associated with obtaining consent from lecturers and students, as well as navigating complex gatekeeping policies, it took us over a year to collect the 460 assignments from 230 students, despite our extensive efforts to reach potential participants through multiple channels. The challenges that we faced when creating the corpus of assessed student writing are similar to those reported by Nesi et al. (2005) when creating the BAWE corpus. Despite these challenges, the number of participants in our study (230 participants) are comparable or even much larger than those from previous longitudinal studies: 15 (Zheng, 2016), 30 (Zaytseva et al., 2021), 31 (Deng et al., 2010), 31 (Knoch et a., 2015), 39 (Mazgutova & Kormos, 2015), 47 (Laufer, 1991), 69 (Storch & Tapper, 2009), and 230 (Olsson, 2021). Having two data collection points is also consistent with the research design of most of these studies. While the data we got for the present study were sufficient to generate reliable findings, future studies which collect and analyze a larger number of assignments written by the same students at different time would provide further insights into the development in L2 writers' use of academic words.

7. Pedagogical implications

This study has several pedagogical implications. The increase in the Education students' use of expert vocabulary across semesters suggests that teachers should not assume that using expert vocabulary is a daunting task for students. In fact, they should draw students' attention to expert vocabulary (e.g., items represented by the AVL) so that they can approach expert-level writing. However, the insignificant change of the Engineering students' use of expert vocabulary across semester indicates that teachers should not assume that the growth of academic vocabulary knowledge is linear. Therefore, they should create opportunities for students to learn expert vocabulary both deliberately (e.g., learning vocabulary from word cards, feedback on lexical choices) and incidentally (e.g., learning vocabulary from viewing academic lectures, reading academic texts). Furthermore, in addition to instructing new words, they should provide learners with opportunities to regularly review known words to consolidate and expand their knowledge of these words. Meanwhile, proficient novice vocabulary (e.g., items represented by the PAVL) is transitional vocabulary from novice writers to expert writers. Knowledge of these words is important for students on degree courses to meet their immediate academic goals (i.e., being successful in assessed assignments). The insignificant changes in the participants' use of these words across semesters suggests that students were unlikely to be able to learn these words incidentally from courses materials. Therefore, teachers could provide explicit instruction to help learners to learn these words, especially those appearing in both the AVL and PAVL. Knowledge of these shared items is particularly important for students in the transition from novice writers to expert writers, because it is relevant to both their immediate and long-term goals. Once students have mastered this shared vocabulary, teachers can direct them to items that are unique to the AVL (expert vocabulary). In this way, teachers can better support students to make a smooth transition from novice writers to expert writers.

This study also found that students' use of academic vocabulary may vary depending on academic disciplines and individual students. EAP instructors should take this complexity into account. In particular, they should support students' development of the vocabulary that is shared among disciplines as well as discipline-specific vocabulary. Moreover, as different students may have different development tracks, teachers could provide students with the AVL and PAVL and instruct them to regularly track their progress of using of expert vocabulary and proficient novice vocabulary. For example, students could use corpus tools such as RANGE and AntWordProfiler (Anthony, 2023) to analyse the proportion of AVL and PAVL words in their assignments throughout their degree studies and adjust their vocabulary accordingly.

8. Conclusion

The present study is the first longitudinal study that has examined the development of L2 learners' use of both expert vocabulary and proficient novice vocabulary in discipline-specific assignments in degree courses. The group analysis found that while Education students' use of expert vocabulary increased significantly from Semester 1 to Semester 2, no significant changes were seen in Engineering students' use of expert vocabulary across semesters. Students' use of proficient novice vocabulary did not significantly change across semesters regardless of disciplines. Analyses of individual students largely support the trends identified from the group analysis, but also showed that lexical development patterns varied according to individuals. While some students used more academic vocabulary in the second semester, others did not, and some even less. Together these findings demonstrate the complex nature of vocabulary development and highlight the importance of tracking students' use of both expert vocabulary and proficient novice vocabulary in their transition from novice writers to expert writers. This study also suggests that individual differences and disciplinary variations should be considered in academic vocabulary instruction.

Notes

[1] In the UK higher education system, a postgraduate program consists of a number of modules. Each module is assigned credit values and focuses on specific aspects of the program. Therefore, module assignments differ from each other in terms of topics.

[2] As these students are considered as international students by their university's admission team, they all completed their undergraduate studies outside the UK.

[3] 134 participants had IELTS scores of at least 6.5 overall or equivalent, 51 had IELTS scores between 5.5 and 6.0 overall or equivalent, and 45 did not report their scores. At the time of the data collection, the participants were studying in discipline-specific courses as part of their degree, not a language course.

[4] Conditional R^2 and marginal R^2 are typical indicators of effects sizes in previous vocabulary studies which used mixed-effects models (e.g., Dang et al., 2022; Vu & Peters, 2021).

CRediT authorship contribution statement

Thi Ngoc Yen Dang: Writing – original draft, Visualization, Supervision, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Huahui Zhao:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Natalie Finlayson:** Writing – review & editing, Investigation, Data curation.

Competing interests declaration

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jslw.2025.101217.

Data Availability

The data that has been used is confidential.

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