Classifying the writing assessment tasks of English as the medium of instruction programs using latent class analysis

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A R T I C L E   I N F O

A B S T R A C T

This study developed a frame to characterize writing tasks required by English as the medium of instruction (EMI) programs and tested it with 55 writing tasks from two EMI programs (creative arts and environmental studies). Results of latent class analysis (LCA) showed: (1) three classes were salient: response-oriented class, argument-oriented class, and description-oriented class; 2) response-oriented tasks dominated creative arts tasks, argument-oriented tasks dominated environmental studies tasks, whereas description-oriented tasks were used as complementary tasks by both programs; and 3) from foundation stage to advanced stages of study, the use of two dominating classes decreased while the use of the complementary class increased. Implications for analyzing EMI writing tasks and for developing language curriculum are discussed.

1. Introduction

The development of higher education in the new millennium has been shaped by two global trends: internationalization (Maringe & Foskett, 2010) and interdisciplinarity (Kreber, 2009), each placing new challenges to the higher education sector. To catch the wave of internationalization, universities in non-English speaking European and East Asian countries have been offering an increasing number of programs with English as the medium of instruction (EMI) (Hughes, 2008; Jenkins, 2014). Meanwhile, in Hong Kong, the English proficiency of local entrants in these countries may not be ready for them to embark on new academic journeys (Toh, 2016), regardless of their British colonial legacy of EMI schools (Evans & Morrison, 2016; Evans, 2009). This unreadiness has been found to be detrimental to the process of knowledge construction (Toh, 2016). In the case of Hong Kong, quite a few studies have been conducted to investigate this English challenge (see, Berman & Cheng, 2010; Evans & Green, 2007; Evans & Morrison, 2011, 2016). Out of these studies, academic writing has emerged as the most challenging language skill to students, among reading, listening and speaking (Evans & Green, 2007; Evans & Morrison, 2011). However, where and how the students fail or are obstructed in their writing practice still awaits further investigation.

One optional solution would be to study the features of writing assignments required by these EMI programs. During the past decades, quite a few studies have been conducted internationally (e.g., Hale et al., 1996; Horowitz, 1986; Melzer, 2014; Zhu, 2004). These studies have successfully elucidated a list of frequently appeared writing assignment text types (e.g., essays, report, case study, critique) across different disciplines (e.g., sciences, social sciences, humanities). A prominent feature of these studies is their overwhelming attention to linguistic features, with a few sporadic mentioning of two elements closely intertwined with language: disciplinary knowledge (e.g., Horowitz, 1986) and thinking skills (e.g., Zhu, 2004). However, as Doiz et al. (2012) cautioned, a good

mastery of English knowledge may not be enough for EMI students to survive their writing tasks. This is mostly because writing itself is a complex process involving appropriate integration of language, disciplinary knowledge and thinking. According to Hyland (2000), writing in academic contexts is to construct new meaning with disciplinary knowledge commonly shared by a specified academic community, and to accommodate possible objections from the community by integrating their language with content. To achieve smooth communication, students must also rely on various generic thinking skills such as analyzing the situations and synthesizing the information before producing their own solutions (Anderson, Krathwohl, & Bloom, 2001). To carve a broad scheme to help EMI students to enhance their writing, more studies are needed to account for these multiple dimensional features of writing tasks.

Adding to the complexity of writing in EMI classrooms is another trend of higher education: interdisciplinarity, wherein programs designed to offer students the opportunity to construct knowledge from 'different core or preferred disciplines' (Davies & Devlin, 2010, p. 3). Under interdisciplinarity, the discipline-specific feature of meaning construction as Hyland (2000) identified should be diluted, given the blurred boundaries among the disciplines. For instance, at the authors' university, there were two EMI programs newly created within the past years: creative arts and global environmental studies. The first program is the merge of fine arts and social culture studies and the second combines natural science and political studies. It would be reasonable to expect that such programs are either discipline-specific and interdisciplinary (Chanock, 2010). Consequently, writing in such interdisciplinary contexts should also bear disciplinary and interdisciplinary features. For instance, their requirements might vary in terms of text types, nature of disciplinary knowledge and thinking skills. Previous studies on writing task analysis, however, have mostly been conducted by assuming discipline-specificity and paid little attention to possible interdisciplinary features.

An additional concern with writing task analysis regards the transitional stages of higher education studies. For instance, undergraduate programs in Hong Kong generally distinguish between a foundation stage (the first two years of undergraduate studies) and the development stage (the last two/three years of studies). This transitional feature has rarely been captured in previous studies. A practical value of distinguishing these stages is to identify the within-program transitional requirements of writing tasks, as identified in studies relied on student writing responses (Gardner & Nesi, 2012).

To enable an in-depth understanding of the writing assignment requirements, the current study sought to develop a multidimensional coding frame to understand the requirements by EMI writing tasks of interdisciplinary programs. To this end, the authors distinguish three dimensions of task features: task genres, disciplinary knowledge and thinking skills. Subsequently, the study examined the interactive distributions of these features among two interdisciplinary EMI programs, and further across different study stages. This was achieved through the creative use of the LCA technique with quantified qualitative codes representing different task features. The next section reviews relevant literature analyzing EMI writing tasks.

2. Writing assignment analysis

2.1. Studies analyzing writing assignment

There has been a long history of analyzing writing tasks used in university classrooms. Horowitz (1986) collected 284 writing prompts from an American university and coded them with a four-category typology: familiarity with a concept (e.g., definition, Physical description, function, and so on), familiarity with the relation between/among concepts (e.g., classifications, results, and so on), familiarity with a process (e.g., process and narration), and familiarity with argumentation (e.g., arguments, thinking, and so on). Horowitz's typology was an earlier example of recognizing the importance of genre features (e.g., narration, argument, descriptions), knowledge types, and thinking skills. However, the blurred boundaries between these three dimensions made the topology difficult to be used by later researchers.

Hale et al. (1996) commissioned an analysis involving five North American universities. Their data included 188 sets of writing assignments from 74 courses covering eight disciplines (e.g., science studies, social sciences and humanities). The coding scheme contained five attributes: locus (i.e., in-class or take-home tasks), length, genre (i.e., essay, report, and proposal), cognitive demands (i.e., retrieving, analyzing, and evaluating), rhetorical mode (i.e., narration, description, exposition, and argument) and pattern of exposition (i.e., classifying, comparing, defining, and so forth). Their results showed that essays and short tasks were the two most common genres, followed by library research papers and reports on experiments. Besides, higher-level cognitive demands appeared to be frequent among all tasks. As for the rhetorical modes, exposition was found to present with all assignments, argumentation present with intermediate frequency, while narration or descriptions did not show at all. Lastly, the study showed that analysis, classification/enumeration, and comparison/contrast were most salient exposition pattern. Hale et al.s' work was an early attempt to frame writing tasks from a multi-dimensional view. Regardless, their coding frame tended to overemphasize the discourse and ignored the nature of disciplinary knowledge. Besides, the study treated task features parallelly, thereby providing little information regarding the interaction these multidimensional elements.

Zhu (2004) examined the categories of writing assignments required by the business courses at an American university. Her main data included 88 writing assignments described in 40 undergraduate course syllabi. Following previous scholars (e.g., Hale et al., 1996), the researcher used a three-dimension coding frame: task genres (e.g., article, report, etc.), cognitive skills (e.g., application, analysis, evaluation, etc.) and rhetorical skills (like Hale and colleagues' concept of rhetorical mode). In the end, the author came up with thirteen genre types: three common in previous studies (i.e., article/book report/critique, the reflection paper, and the library research paper), and nine new/specific to business writing (i.e., case analysis, article/book report, business report, business proposal and reflection paper). The researcher found that higher order thinking (e.g., analyzing and evaluating) were frequently involved for processing different types of disciplinary knowledge (e.g., concepts, theories, procedures, etc.). Four rhetorical modes were found to

frequently appear among the business writing assignments: problem-solution, comparison, process, and enumeration. Zhu's study represented the new trend of writing assignment analysis to tap into the interactive relationships among multiple task features. However, as the number of task types were merely the counts of raw occurrence, it is not sure whether some types can go together. If this is true, then the number of tasks types might have been artificially increased due to the limited power of descriptive data analysis. Second, although the author rightly looked at the interaction among features of different dimensions, the classification results were still mainly drawn from genre types, leaving the interactive relationship elusive to capture.

A most recent study was done by Melzer (2014), which examined the variety of writing assignments demanded by college courses across a variety of disciplines. The author collected over 2000 writing assignments from 400 undergraduate courses evenly distributed among four areas of studies (i.e., natural and applied sciences, social sciences, business, and arts and humanities). Melzer adapted a coding frame containing four categories of indicators: expressive assignments (with the self as audience), poetic assignments (with a focus on the text as art form), transactional assignments (to inform or persuade an audience), and exploratory assignments (with the public as the audience). Results of descriptive statistics showed transactional assignments made up 83% of her sample (66% informative and 17% persuasive), whereas the portion for exploratory assignments was merely 13%. As this coding frame was originally developed for secondary school studies, half of the indicators were inappropriate for undergraduate studies (e.g., expressive and poetic assignments). Besides, the coding frame made no reference to disciplinary knowledge and cognitive skills.

The last study to mention is the work by Carstens (2008). This study focused on the written genres and rhetorical modes required by different academic departments at an African university. Data included 182 writing assignments collected from eight departments at the Faculty of Humanities, including Visual Arts, Historical and Heritage Studies, Political Sciences, and so forth. The author assigned a genre label to each assignment using a coding scheme consisting of 10 indicators (e.g., essay, case study, report, critical analysis, etc.). The task prompts with coded genre labels were then sorted by disciplines and put into Wordsmith (a tool for corpus linguistics research). Next, the researcher determined one rhetorical mode for each task, out of a list of modes such as analysis, argumentation, cause and effect. Results of concordance building (i.e., searching for word frequency in the corpus) showed that, essays, report and critical analysis were the most salient genres in the dataset. Specifically, for the ten assignments by Visual Arts, the largest portion was essays, followed by critical analysis and reports. Another department, Political Science, contributed 14 tasks, among which the largest portion was essays, followed by critical analysis and reports. With respect to rhetorical modes, the study showed that discussion occurred in all tasks. Other salient modes included analysis, description, explanation and argument. Carsten's study is valuable not only for its setting in a university outside the United States, the educational system dominating existing studies of writing task analysis, but also for its inclusion of disciplines rarely covered in other studies, such as visual arts. However, quite obviously, this study gave exclusive attention to discourse features by ignoring disciplinary knowledge and thinking skills. No attention was given to the transitional feature of task assignments either.

A brief review of the literature shows at least four substantial limitations in previous studies: inconsistent use of classification criteria (Gardner & Nesi, 2012), overemphasis on discourse features at the sacrifice of the nature of disciplinary knowledge and thinking skills, the absence of accounting for the transitional feature of undergraduate studies, and an exclusive focus on disciplinary-specific EMI programs. The last limitation to mention deals with the rigor of research methodology. All studies reviewed relied on descriptive statistics for data analysis, in which the researchers first coded the writing tasks with a predetermined classification frame consisting of a list of indicators and then calculated the prevalence of these indicators. Results built on this method alone could bear incurable flaws caused by human errors during task coding, task grouping purely based on the natural occurrence of indicators, ignorance of dependence between indicators. Moreover, descriptive statistics can at most provide piecemeal information of the occurrence of indicators, which prohibits an integrative understanding regarding how different task features interact with others in defining a group of tasks.

2.2. Latent Class Analysis: a new approach for analyzing writing assignment

Advances in statistics now offer an appropriate statistical model to overcome the limitation of descriptive statistics exclusively used in previous studies— Latent Class Analysis (LCA) (Vermunt & Magidson, 2004). LCA is an optimal tool for classifying cases according to a construct not directly observable (Lanza, Bray, & Collins, 2013), for example, writing assignment class. It is an exploratory multivariate analytical technique like factor analysis (B. Muthén & Muthén, 2000). The difference is that, while factor analysis clusters items, LCA clusters cases (i.e., writing tasks in our study), which again makes LCA like cluster analysis. However, LCA is considered more powerful than cluster analysis for more accurate estimations of cluster means and more accurate assignment of class membership (Magidson & Vermunt, 2002). For the current study, as LCA assumes writing assignment class as a latent factor to be explored based on the human-coded indicators, this approach would make human coded data more tractable and less error-prone than traditional use of summary statistics (e.g., means or percentages). LCA can also reduce the probability of coding errors (e.g., the assignment of a code to a task in one program is influenced by how other tasks in the program are coded) by accounting for the dependence among all indicators in the model. Moreover, the aim of LCA is to identify classes in the whole population of cases in terms of all observed indicators (Lanza & Cooper, 2016). By examining the similarity within the class and difference across the classes, one can understand crucial but nuanced patterns hidden beneath means or percentages (Williams & Kibowski, 2016), thereby providing an integrated view of writing task features.

Table 1
Distributions of writing assignments by study stages and programs.

Programs	Foundation Stage	Development Stage	Subtotal
Program A (Creative Arts)	13/9	17/22	30/21
Program B (Environmental Studies)	10/6	15/14	25/20
Total			55/41

3. The study

3.1. Research questions

The current study addressed two major questions:

1) Can the writing assessments of the two interdisciplinary EMI programs (i.e., creative arts and environmental studies) be grouped into distinct and meaningful types? How do different types of writing assessments distribute across the two EMI programs?
2) How do different types of writing assessments distribute across different stages of undergraduate study (i.e., foundation stage and development stage)? Does this transition differ across the two EMI programs?

3.2. Data and materials

Data were collected from two interdisciplinary EMI programs: creative arts (Program A) and environmental studies (Program B). We used course outlines (obtained with the permission of the Dean and from the offices of the two programs) as the primary source of data to identify information for writing assessment tasks for two reasons. First, course outlines (or syllabi) explain what students are expected to learn and what activities students need to do to fulfill program requirements. Second, course outlines are a primary means of communication between the university, course instructors, and students. At the university, program-based courses usually include four categories: foundation courses, major compulsory, major selective and minor courses. For the current study, we included all four categories of course outlines from each selected EMI program. In our final dataset, there were 41 course outlines (21 from Program A and 20 from Program B) with a total number of 55 writing tasks (30 representing Program A and 25 representing Program B). The details are show in Table 1.

A typical course outline in our dataset included a summary of instruction contents, a list of intended learning outcomes (usually addressing requirements on disciplinary knowledge and generic thinking skills), a table categorizing teaching content, activities, and assessment tasks (major information for the current study) with corresponding intended learning outcomes. With very few exceptions, a prompt of writing assignment would provide information about the genres of the text (i.e., report or essay, goals of communication, etc.), content or issues to be covered, and cognitive activities to be conducted (e.g., to analyze, to evaluate, etc.). Other information included descriptive requirements for text length and score weighting in the final grade.

3.3. Task coding frame

We first determined a three-dimensional coding frame containing genres, disciplinary knowledge and thinking. When labelling writing task genres, we were aware of the data-driven approach that used original genre labels offered in course syllabi (e.g., Zhu, 2004). However, such an approach has become controversial in recent years for their reliance on superficial labels loosely provided by course instructors (Gardner & Nesi, 2012). We are also aware of different traditions of genre research, which include the English for Academic Purposes approach (Swales, 1990), the new rhetoric approach (Miller, 1984), and the Systemic Functional Linguistics approach (Martin, 2005). We are also aware of the 'Academic Literacy' approach (Lea & Street, 2006) that emphasizes social aspects of educational activities and possible variation of assignment demands due to digital technology (Bhatt, 2017). By comparing these approaches with the writing task prompts in our data, we chose to use the approach of educational genres specified by the Systemic Functional Linguistics scholar Rose (2015). Besides, we extended his frame to include disciplinary knowledge and thinking, given the importance of these two dimensions pointed out earlier. To categorize elements under these two constructs, we adopted the updated version of Bloom's taxonomy (Anderson et al., 2001).

During the coding process, we detected frequent use of words such as 'movement', 'force', and 'speed' for specifying disciplinary knowledge in creative arts courses. This type of disciplinary knowledge corresponded to the knowledge type found by Carsten (2008), or the knowledge that students had to rely on to evaluate works of arts, exhibitions, and artefacts for accomplishing writing. We contend that this type of disciplinary knowledge fall into Bloom's procedural knowledge, but bear a different flavor (i.e., knowing the kinetic procedures of a dance or a painting) from procedural knowledge in the more general sense (e.g., knowing the procedures of collecting water samples in environmental studies). For this concern, we distinguished kinetic procedural knowledge from general procedural knowledge in our coding.

The final version of our coding frame contained 12 indicators falling into three dimensions: rhetorical modes (i.e., explanations, reports, directing, responses/critique, and arguments), disciplinary knowledge (i.e., factual, conceptual, general procedural, and kinetic procedural knowledge), and thinking (i.e., understanding, applying, analyzing, evaluating and creating). Anderson et al.

Table 2
The writing task coding frame.

Dimensions	Measures	Descriptions of features
Genres/Rhetorical modes	Explanations	Sequential explanation, Factorial explanation, Consequential explanation
	Reports	Descriptive report, Classifying report, Compositional report
	Directing	Procedure direction, Protocol, Procedural recount
	Arguments (persuading)	Exposition, Discussion
	Text responses	Personal response, Review, Interpretation
Disciplinary knowledge	Factual knowledge	The basic elements used for problem solving
	Conceptual knowledge	The interrelationships among the basic elements
	Procedural knowledge (general)	How to do something
	Procedural knowledge (kinetic)	Kinetic knowledge for creative arts
Thinking skills	Understanding	Cognitive processes that builds connections between old and new knowledge
	Applying	Cognitive processes that involve performing exercises or solving problems
	Analyzing	Cognitive processes that involve breaking materials into parts and determining relationships between the parts
	Evaluating	Making judgments based on criteria and standards
	Creating	Putting elements together to for a coherent or functional whole

(2001) proposed that a higher-level thinking skill (e.g., creating) should also involve all other thinking skills at the lower levels. This overarching concept of thinking was adopted in our study. That is, a writing task was usually assigned the highest level of thinking as interpreted by the researchers. However, multiple assignments of thinking levels were allowed for tasks that put additional emphasis on lower levels of thinking. Detailed coding information is shown in Table 2.

3.4. Procedures of coding and analysis

The current study applied a qualitative content analysis approach (Schreier, 2013) to code writing tasks. First, two researchers each coded the same ten tasks randomly selected from the 55 writing assignments. After that, the two researchers met and discussed the codes not used or new codes identified before coming up with a revised coding frame. Next, the coding results were compared and disagreements discussed. This process was repeated until an interrater reliability (Cohen's kappa) above 80% was established. These codes were then used to identify conceptually meaningful patterns with the classification technique of LCA.

LCA modeling involves a series of steps. First, a researcher fits a series of models (usually from a 1-class model to a k-class model, say, 5-class model) to the data and then compares each new model (e.g., the 4-class model) with the old model (i.e., the 3-class model). The researcher will select a new model if this model results in a better statistical fit and provides meaningful groupings. LCA in this study was conducted on Mplus 7.4 (Muthén & Muthén, 1998–2015Muthén and Muthén, 1998Muthén & Muthén, 1998–2015) using the estimator of Robust Maximum Likelihood (MLR). Model evaluation was based on multiple statistical indices. Log likelihood value (LL), Akaike information criterion (AIC), Bayesian information criterion (BIC) with lower values indicate better fit of a corresponding model. Complementary indices for model comparison include the *p*-value for the Lo-Mendell-Rubin adjusted Likelihood Ratio Test (LRT), and the *p*-value for bootstrap likelihood ratio test (BLRT). The significance of these *p*-values indicates the new model (e.g., 3-class model) fits better, while non-significance indicates the old model (e.g., 2-class model) fits better (Nylund, Asparouhov, & Muthén, 2007). Besides, an entropy value larger than .80 indicate good classification quality (Nylund et al., 2007).

4. Results

Latent class models of k = 1–5 classes were fit to the data. The model fit indices are presented in Table 3. The BIC values (mostly used criteria for determining the number of classes in the literature) suggested the 3-class model is the optimal model. The entropy value of .998 for the 3-class model indicated that this model correctly classified individual tasks into their respective groups accurately 99.8% of the time. Besides, the non-significant *p*-values of the BLRT and LRT for the 4-class model indicated that the model with an additional class performed no better than the 3-class model. Given these statistics, the 3-class solution was selected.

The resulting 3-class model represented three distinct types of writing assignments. The characteristics of each group were determined by examining the probabilities of different task measures. These statistics are shown in Table 4.

Table 3
Model fit statistics for latent class models.

Model	AIC	BIC	Adjusted BIC	LL	Entropy	BLRT	LRT
1 One-class	807.902	836.004	792.012	− 389.951	1.000	NA	NA
2 Two-class	737.887	796.1	704.972	− 339.944	0.975	< .008	< .009
3 Three-class	677.46	765.783	627.52	− 294.73	0.998	< .001	< .001
4 Four-class	678.195	796.628	611.23	− 280.098	0.998	< .133	< .139
5 Five-class	690.387	838.93	606.397	− 271.194	0.989	< .414	< .420

Table 4
Item probabilities from the 3-class model.

Dimensions	Measures	Occurrence	Class 1 Responses	Class 2 Arguments	Class 3 Descriptions
Genres/ Rhetorical modes	Explanations	1	1.000	0.000	0.000
	Descriptions	13	0.078	0.000	0.922
	Directing	2	0.000	0.000	1.000
	Arguments	20	0.000	0.950	0.050
	Responses	20	0.999	0.000	0.001
Disciplinary Knowledge	Factual	11	0.201	0.000	0.799
	Conceptual	53	0.404	0.365	0.232
	Procedural (general)	23	0.183	0.318	0.500
	Procedural (kinetic)	19	0.683	0.000	0.317
Thinking Skills	Understanding	23	0.347	0.261	0.392
	Applying	20	0.209	0.158	0.633
	Analyzing	40	0.450	0.449	0.100
	Evaluating	42	0.429	0.451	0.120
	Creating	12	0.083	0.665	0.252
Programs	Program A	–	0.633	0.033	0.334
	Program B	–	0.080	0.719	0.201
Stages (Programs)	Foundation (Program A)	–	0.647	0.056	0.297
	Development (Program A)	–	0.615	0.024	0.361
	Foundation (Program B)	–	0.060	0.822	0.118
	Development (Program B)	–	0.102	0.640	0.258
Overall (portion of tasks)		–	0.382	0.345	0.274

Class 1 tasks were best represented by two rhetorical modes, that is, explanation and responses. Given that there was only one task falling into the explanations category, we named this class as *response-oriented tasks* for the sake of brevity. With respect to disciplinary knowledge, this first class appeared to have a high probability of involving artisan knowledge and intermediate probabilities of involving analysis and evaluation. Class 2 tasks had perfect probability of accounting for two rhetorical modes, namely, *directing* and *arguments*. As with *explanation* in Class 1, *directing* in Class 2 had scarce presence; hence, we labeled Class 2 as *argument-oriented tasks*. Scrolling down Table 3, one can find that *argument-oriented tasks* are more prone to go with conceptual and procedural knowledge and with evaluation at the highest level of thinking skills. This class occupied 34.5% of the total number of 55 tasks. The last class identified, or Class 3, involved only one rhetorical mode of descriptions, thereby the label of *description-oriented tasks*. This class had the high probability of going with factual knowledge (79.9%) on the knowledge dimension and application (39.2%) on the thinking dimension. This is the smallest class and consisted of 27.4% of the total sampled tasks.

The fourth block row in Table 4 shows the distributions of the three classes across programs. As shown, a writing assignment from Program A (creative arts) had the highest probability (63.3%) of falling into Class 1 (response-oriented tasks), followed by a 33.4% probability of falling into Class *3 (description-oriented tasks)*. The least probable class for a Program A task to belong to was Class 2 (argument-oriented tasks), which was as small as 3.3% of the time. A writing task from Program B (environmental study) had the highest probability (71.9%) of falling into Class 2 (argument-oriented tasks), followed by the probabilities of 20.1% falling into Class 3 (description-oriented tasks) and 8% falling into Class 1 (response-oriented tasks).

The fifth block row in Table 4 presents the transition of different classes of writing assignments from the foundation stage to the development stage for each program. A reader-friendly diagram illustrating the transition is also provided in Fig. 1. For Program A (creative arts), response-oriented tasks and argument-oriented tasks displayed decreased probabilities of occurrence (from 64.7% to 61.5%, and from 5.6% to 2.4%, respectively), whereas description-oriented tasks showed increased probability of occurrence (from 29.7% to 36.1%). Program B (environmental study) had two transition patterns similar to Program A: one regarding the decreased occurrence probability of argument-oriented tasks (from 82.2% to 64%) and the other regarding the increase in description-oriented tasks (from 11.8% to 25.8%). The difference is that, in contrast to the decrease in response-oriented tasks in Program A, the occurrence probability of this class of tasks increased (from 6% to 10.2%).

5. Discussion

Learning how to tackle various writing assignments in university classrooms is one of the most difficult tasks for students (Creme & Lea, 2008). The case becomes even severer for EMI students whose first language is not English (Evans & Morrison, 2011). This difficulty does not always lie in the demands of academic writing for higher English proficiency or for technical vocabulary particular to certain disciplines (Malmström, Pecorari, & Gustafsson, 2016). It also lies in the fact that the textual organizations of academic writing usually vary across disciplines (Hyland, 2008), and that academic writing tasks in different disciplines differ in terms of their demands on disciplinary knowledge (Creme & Lea, 2008) and thinking (Warburton, 2007). To understand the different features of writing assignments by two interdisciplinary EMI programs (creative arts and environmental studies), the current study developed a coding scheme accounting for multiple dimensions of academic writing: genres (i.e., rhetorical modes), disciplinary knowledge and
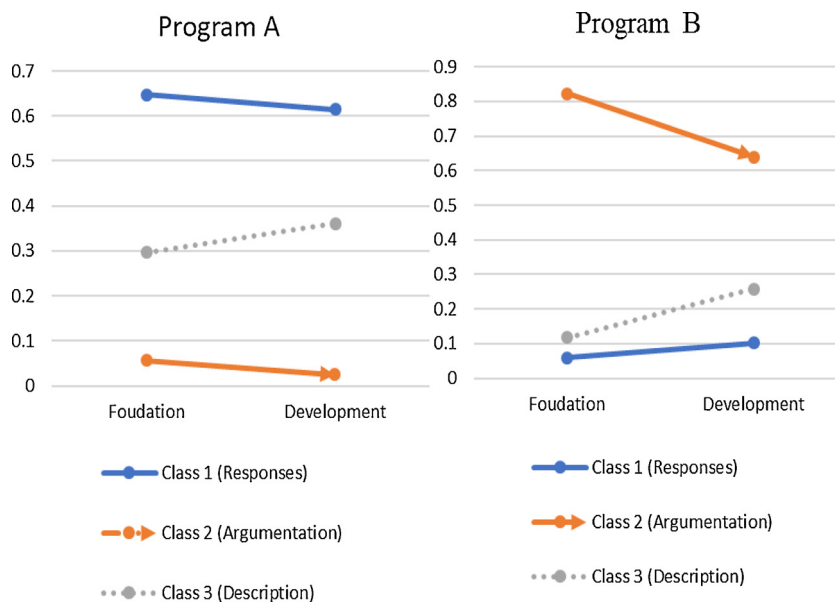
Fig. 1. Transition of writing assignment classes.
Note. Vertical axis = probability; Horizontal axis = stage.

thinking skills.

Question 1. Can the writing assessments of the two interdisciplinary EMI programs (i.e., creative arts and environmental studies) be grouped into distinct and meaningful types? How do different types of writing assessments distribute across the two EMI programs?

Drawing on the sophisticated statistical technique of LCA, the study identified three main classes of writing assignments: response-oriented tasks (Class 1), argument-oriented tasks (Class 2), and description-oriented tasks (Class 3).

Response-oriented tasks was the most salient group (the largest class). A writing assignment task falling into this class had the highest probability of demanding writing for a response paper. Referring to the framework of educational genres (Rose, 2015), a response task in our data can be further distinguished into a review task (e.g., evaluating a verbal, visual, or musical text) or a critique task (e.g., critical review of an academic text). As for the demands on disciplinary knowledge, a task of this class (including one explanations task) had a relatively higher probability of involving kinetic procedural knowledge in arts than involving other types of disciplinary knowledge. Finally, a response-oriented task had higher probability of involving higher-level thinking skills along Bloom's taxonomy of thinking level, such as analysis and evaluation, than involving lower-level thinking skills such as understanding and applying. However, this type of task barely involved creative thinking at the highest end of thinking skills. Substantially, this means response-oriented tasks that dominated the writing assignments in creative arts rarely required students to demonstrate their original ideas.

A further look at the distributions of response-oriented tasks across the two EMI programs may help to better understand the class of tasks. The distribution information presented in the fourth block row in Table 3 indicated that creative arts tasks had a probability of 63.3% falling into this category, in contrast to 8% for environmental study tasks. Combined with our discussion in the previous paragraph, we concluded that, for most of the time, a writing task for creative arts would ask students to produce a written text out of their critical analysis and evaluation of a piece of artwork (e.g., a piece of painting, music, or dance work), by using their kinetic procedural knowledge in arts.

The prevalence of response-oriented tasks among creative arts courses was similar to what was found in Carstens (2008). In that study, the researcher identified four tasks out of the ten Visual Arts assignments, which were categorized as *critical analysis tasks*. According to Carstens, this type of task shared a common feature in demanding students write a continuous text by responding to certain artwork and support their statements with evidence. Carstens pointed out that the nature of this type of tasks also put high demands on students' critical analysis skill. Although Carstens made no distinction between different types of disciplinary knowledge or between different levels of thinking skills involved, it is obvious that the response-oriented tasks identified in our study and the critical analysis tasks identified in Cartsens shared some similar features: both demanded the rhetorical mode of text responses (including review or critique), kinetic procedural knowledge, and higher-level thinking skills such as analysis and evaluation.

The second largest class, the argument-oriented tasks, involved 34.5% of the total number of tasks in our sample. This class obtained its label because a task falling into this category had the highest probability (95%) of demanding an argumentative text. By referring to Rose (2015), argument-oriented tasks in our data could be further divided into micro modes such as exposition (supporting a single point of view) and discussion (discussing multiple points of views). The item probabilities for disciplinary knowledge corresponded to the argument-oriented class indicated that, this type of tasks bore mediate probability of demanding for conceptual

and procedural knowledge, in contrast to a zero probability of demanding for factual knowledge and kinetic procedural knowledge in arts. With respect to thinking skills, argument-oriented tasks tended to have the highest probabilities of demanding creative thinking (the highest-level thinking skill), together with relatively lower probabilities of demanding analysis and evaluation, and even lower probabilities for demanding understanding and analysis.

A reference to the distributions of argument-oriented tasks of each program helps to explain these features. The probability of an argument-oriented task falling into Program B (environmental studies) was as high as 71.9% versus the probability of 3.3% falling into Program A (creative arts). This indicated argument-oriented tasks occurred more possibly with global environmental studies. The salience of argument-oriented tasks with environmental studies corroborates the belief in writing education that essay writing is at the heart of education (Warburton, 2007). This finding, however, is only partly in line with what was found in Hale et al. (1996) that argumentation presented only with intermediate frequency in disciplines such as business, chemistry, and computer science (disciplines comparable to some of the environmental studies courses in the current study).

The predominant prevalence of argument-oriented tasks in environment studies courses is inconsistent with Melzer's (2014) national survey. Melzer found 83% of the writing tasks fell into the category of transactional assignments, among which 66% was informative (e.g., descriptions) and only 17% was persuasive (i.e., arguments or responses). Although Melzer did not provide detailed information regarding the source disciplines of the portion of informative tasks, it can be inferred that persuasive tasks were rare with disciplines in social sciences. The reason for the underuse of informative tasks that Melzer found could be read from her narration about the interviews with subject instructors. As the zoology and physics instructors recounted, although they appreciated the important role of persuasive tasks for assisting learning, they were still reluctant to assign too many persuasive tasks, so as to avoid putting their students in a difficult situation. The reason for this avoidance should be due to the instructors' belief that persuasive tasks are too demanding for higher-level thinking. Such concerns by science teachers, however, did not appear to thwart the dominant use of argument-oriented writing tasks in the program relevant to environmental studies in our study. Our interpretation of this difference deals with the specific disciplinary features of the program in our study. As introduced earlier, environmental studies at the sampled university is an interdisciplinary program closely weaved with multiple disciplines including politics and economics. This amalgamation makes environmental studies itself filled with contents of controversial issues. This is perhaps one of the reasons why assignments used in environmental studies are dominated by argument-oriented tasks, which meanwhile had high demands for higher-level thinking skills such as creative thinking (i.e., students have to find a solution to a specified issue).

Class 3 was the smallest class (description-oriented tasks), containing only 24.7% of the total writing assessment tasks. This class had a high probability of endorsing the rhetorical mode of reports/descriptions, which contained three micro modes: descriptive reports that describe one type of things, classifying reports that describe different things, and compositional reports that describe parts of wholes (Rose, 2015). An interesting finding about this class regards its more possible demand for lower-level disciplinary knowledge (i.e., factual knowledge) and lower-level thinking (i.e., application), versus its lower possible demands for higher-level knowledge (i.e., procedural knowledge) and higher-level thinking (i.e., evaluation and creation).

The prevalence of description-oriented tasks in the current study, however, was inconsistent with the absence of description tasks observed in Hale et al.'s (1996) large-scale study conducted in the United States. The emergence of description-oriented tasks in our study, however, corroborated findings from studies conducted relatively more recently. For instance, Zhu (2004) observed the frequent presence of process and enumeration tasks (similar to description-oriented tasks in our study) in the business courses syllabi. Moreover, in Melzer's (2014) nationwide survey of university writing tasks, roughly 55% of the total number of 2000 assignments were identified as informative tasks (under which descriptions tasks were subsumed). Built on this evidence, there seemed to be an increasing trend in using description-oriented writing tasks in university classrooms. While discussions over this trend is out of the scope of this paper, we tend to believe that this evolution might have resulted from the assumed evolution of disciplinary curricula over the years.

Question 2. How do different types of writing assessments distribute across different stages of undergraduate study (i.e., foundation stage and development stage)? Does this transition differ across the two EMI programs?

This question relates to the distribution transition of different writing tasks from the foundation stage to the development stage. For both programs, the use of argument-oriented tasks decreased, whereas the use of descriptions-tasks increased during the advanced stage. The counter-direction transition of the two types of writing assignment tasks corroborated Gardner and Nesi's (2012) observation of writing task transition using student writing corpus British Academic Written English. In their study, essay writing was found to decrease from 50% at Level 1 to 31% at Level 4; on the contrary, research reports (similar to description-oriented tasks) increased from 1% at Level 1 to 36% at Level 4. The researchers explained the transition pattern was due to the nature of different types of tasks: essay writing is a pedagogical genre that is rarely used in workplaces outside academic settings, whereas report writing is more profession-oriented. Based on this idea, the counter-direction transition involving argument-oriented tasks and description-oriented tasks in the current study reflected a profession-oriented recommendation for use of writing tasks. Our interpretation for the transition could also be confirmed by our interviews with the program leaders. As one program leader reported, writing is important for their students because their future careers will frequently involve tasks such as writing a proposal to bid for money for an exhibition. Another program leader also mentioned, during the interview, an awareness of workplace-oriented learning has almost become a hiddden curriculum during their curriculum development.

The transition of the response-oriented class in the two programs, however, is not consistent. While the probability of using response-oriented tasks tended to decrease in the development stage for creative arts, the trend for environmental studies was opposite, a pattern similar to the increased use of critique tasks found in Gardner and Nesi (2012). Our interpretations are twofold. First, as with essays, responses (or critiques) are also pedagogical and specific to academic writing. Hence, the idea of practical

recommendation should also be applicable for explaining the declined use of response-oriented tasks in creative arts. As for the increased use of response-oriented tasks for environmental studies, our interpretation is consistent with Gardner and Nesi (2012): both programs in our study tended to use various types of writing tasks during the whole course of disciplinary studies. This idea can be partly supported by the decreasing trend with the dominating class in each program during the foundation stage (e.g., response-oriented tasks for creative arts and argument-oriented tasks for environmental studies) and by the increasing trend found with the lower-probability class of each program (e.g., response-oriented tasks for environmental studies and desciptions-oriented tasks for both programs).

A combined considerations of these class transition patterns would provide a more comprehensive view of the picture. To summarize our discussion, perhaps a good point to start with is description-oriented tasks. Recall our earlier discussion that this class of tasks combined the descriptive mode with low demands on disciplinary knowledge (i.e., factural knowledge) or thinking (i.e., applying). The increasing trend of this class for both programs, combined with the decreasing trends of the dominating classes for each program (i.e., response-oriented tasks for creative arts and argument-oriented tasks for environmental studies), suggested that as disciplinary study progressed, academic writing in both programs gradually become less challenging. This decrease is not only reflected in rhetorical modes (i.e., from more challenging modes such as response and argument papers to less challenging decription papers), but also in disciplinary knowledge (from higher-level conceptual and procedural knowledge to lower-level factural knowledge), and in thinking (i.e., from higher-level creative and evaluating thinking to applying).

6. Conclusions

The current study proposed a three-dimensional writing task coding frame and examined the writing assessment tasks used by two interdisciplinary EMI programs. Using the LCA approach, the study identified three distinct classes (types) of writing assignments, based on their descriptions of genres (i.e., rhetorical modes), disciplinary knowledge and thinking skills. These classes were named as response-oriented tasks (with a high demand for kinetic procedural knowledge and higher-level thinking skills such as analyzing and evaluating), argument-oriented tasks (with a high demand for conceptual and procedural knowledge and for creative thinking), and description-oriented tasks (with a high demand for factual knowledge and for low-level thinking of applying). Among these classes, response-oriented tasks and the argument-oriented tasks dominated the writing assignment tasks for creative arts and for environmental studies, respectively; meanwhile, description-oriented tasks covered a complementary portion of tasks for each program.

A transition analysis of the distribution of different types of writing tasks during the foundation stage and the development stage of study revealed the decreased occurrence of the dominating class for each program (i.e., response-oriented tasks for creative arts and argument-oriented tasks for environmental studies), accompanied by the increased occurrence of response-oriented tasks for each program. Overall, writing assignment tasks used by the two programs tended to become less challenging with the transitional stages of study.

The present study contributed to research and practice in the field in several ways. First, this was the first writing assignment analysis that systematically considered the multiple dimensions of writing assignments, namely, task genres (i.e., rhetorical modes), disciplinary knowledge and thinking skills. This relatively comprehensive approach should better fit in the actual situation of EMI programs than previous ones overemphasizing discourse issues. Second, the present study used LCA, an advanced statistical technique that has been developed for classification. This approach allowed us to base our judgement on scientific evidence (i.e., statistical modeling indices) rather than on intuitive impression on descriptive statistics as used in previous studies, thereby making our results more convincing. Moreover, LCA allowed us to explore the commonality and distinction among individual tasks, rather than only to provide a count of occurrence frequency of each measure. This LCA based presentation is more comprehensive, concise, and comprehensible than simply presenting a lengthy list of the counts of each measure for each task. An additional strength of the current study was the double-rater coding strategy we use to enhance inter-rater reliability. To our best knowledge, very few studies have reported such an approach.

The findings of the current study have several implications. First, our three-dimensional coding frame is generalizable to writing tasks analysis for EMI programs such as creative arts and environmental studies. This coding frame should also be generalizable to writing task analysis for EMI programs in other disciplines relevant to social sciences or humanities. Methodologically, the current study demonstrated in detail the procedures to use LCA with quantified qualitative data for writing task analysis. Drawing on its latent factor modeling feature, this approach has the great potential of enhancing the accuracy of research findings by clamping down flaws due to intuitive human decision in task coding and grouping. Besides, its ability to account for the concurrent occurrence of all dimensions of writing task requirement enables a more holistic and straightforward view of the interaction among these dimensions. More usefully, by adding to the model a time predictor such as study stage, the method can present a dynamic picture of the interaction across time. Future studies are encouraged to apply this powerful technique optimal for classifying objects.

Practically, the salient writing task types identified with each program during different stages provide useful and granular information for curriculum developers, instructors and textbook writers. For instance, curriculum developers for academic writing in global environmental studies at the university can focus their curriculum contents on argumentative essays, while at the same time give priority to conceptual and procedural knowledge and to creative thinking, when determining the task contents and cognitive demands. For the studies of creative arts, on the other hand, curriculum contents may emphasize reports (i.e., text responses or critique) and prioritize the demand for kinetic procedural knowledge in arts and for higher-level thinking skills such as analysis and evaluation. Besides, curriculum contents can be staged in such a way that, during the foundation stage, more attention is given to argumentative essays for global environmental studies, or to text responses writing for creative arts studies. Besides, relatively more attention can be directed to descriptions tasks for both programs during the development stage, as compared with the foundation

stage.

Our study had several limitations. First, we were not able to include actual student papers for task analysis. This was mainly due to the unavailability of student papers at the development stage at the time of data collection (a large portion of the students were off campus for their internships). Second, the current study only contained 55 writing tasks from two EMI programs at one university in Hong Kong, thereby limiting the variety of task types. This is of concern because, as observed in previous studies, academic writing varies depending on factors such as academic disciplines and educational systems. Nevertheless, this limitation does not constrain the significance of the current study for its insights provided for developing writing enhancement programs for the two EMI programs at the participating university, nor constrain the significance of the procedures and technique applied for writing task analysis research.

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