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Transfer of Learning in a Multimodal, Collaborative ESAP Writing Program: Assessing Engineering Graduates' Perceptions via the LTSI

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Abstract

Transfer of learning from English course to other contexts is one of the most fundamental objectives of English for Special Academic Purposes (ESAP) instruction. Providing opportunities to transfer the acquired knowledge from the ESAP writing course to writing tasks of specialized disciplines as well as analyzing students' perceptions of transfer catalysts and barriers might suggest a foundation for future educational planning. This study examines how engineering graduate students who participated in an ESAP course assessed the four constructs of learning transfer inventory that might facilitate or inhibit the transfer of learning in discipline-specific academic writing programs. Sixty engineering graduate students participated in this study. During the ESAP course, collaboratively designed discipline-specific writing tasks were presented and practiced through multimodal input. The variation in participants' writing skills throughout the semester was recorded and analyzed. The catalysts and the barriers to the learning transfer act were identified by administering the Learning Transfer System Inventory (LTSI). The participants' evaluations of the treatment they had received was assessed through a focus group interview. Results indicated that the students could obtain significant levels of academic writing skills and finally transfer their acquired instruction to authentic

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discipline practices. Furthermore, data analysis of the LTSI demonstrated that transfer of writing outcomes will be increased if more consideration of work-related factors is considered in higher education. All participants reported personal capacity as the main impediment induced by the work-related construct. Students' positive attitudes toward three ability factors and all motivational factors suggested that an auspicious foundation for future educational planning exists if disciplinary and institutional considerations are embraced.

***Keywords*:** learning transfer, academic writing, the LTSI, collaborative planning

1. Introduction

Academic writing provides students with the opportunity to display their comprehension of acquired knowledge, experience, and skills which is regarded as a focus for university students (Shrestha & Coffin, 2012) especially graduate students who are supposed to write effectively from the very beginning (Lillis & Turner, 2001).

Nevertheless, the studies on academic writing in the field of engineering maintain that engineering students face problems while writing academically, especially when they need to submit theses, articles, and reports (Cusick, 2009). These challenges are more recognizable in the Iranian context, where graduate engineering students need to write in a non-native language (Mousavi & Kashefian-Naeeini, 2011). In spite of its importance in higher education, no academic writing course has been defined in the graduate programs of engineering disciplines by the Ministry of Science, Research, and Technology. Consequently, generic and rhetorical conventions essential for producing academic texts have received little or no attention. The English courses in these disciplines are confined to three-credit and two-credit courses presented in bachelor programs (Mousavi & Kashefian-Naeeini, 2011) that mainly provide practice in reading and translation skills (Naghdipour, 2016). They enable students to read and comprehend discipline-specific texts and use scientific English sources (Saffarzadeh, 2016); however, the very crucial area of academic writing seems to have received scant attention.

On the other hand, PhD students in Iran are required to publish at least a thesis-extracted paper in a scholarly journal before they are given permission to formally defend their theses. This condition is, however, optional for MA/MSc students. This highlights the importance of developing materials that cater for the real needs of thousands of graduate students who need to practice academic writing tasks and strategies (Sajid & Siddiqui, 2015). In addition, it seems that academic writing courses that are presented by language instructors can hardly fulfill this demand, because of a lack of a broad understanding of the students' discipline-specific needs. As a result, the collaboration between discipline-specific and language lecturers seems to be necessary (Bhatia, 2014).

The degree of similarity between the authentic practice of the task and the instructional situation can affect language transfer (James, 2014). Students may not transfer learning outcomes from an ESAP writing course if they do not find a connection between the writing course and other courses (Ford, 2004).

Collaboration of instructors from different disciplines can provide a discipline-specific situation through developing instructional materials that are similar to ESAP students' professional settings and suit their educational needs and expectations, and therefore, assist them in transferring their learning from an ESAP course to a content-based context.

Learning transfer occurs "when learning in one context or with one set of materials impacts on performance in another context or with another set of materials" (Perkins & Salomon, 1994, p.6452). Traditional teaching method and techniques were not effective in helping students apply the acquired knowledge in later classes or professional work (Archer et al., 2014). This phenomenon is not automatic and may not be easy to stimulate. This is possible through instruction designed to promote transfer of learning (Hajian, 2019). It might be right to say that the true motivation to transfer is a challenge for engineering students (Baillie & Fitzgerald, 2000) due to the reason that not all students make meaning through linguistic written or speech modes, and this may demotivate learners.

Subedi (2004) considered learner characteristics and workplace characteristics as significant factors affecting learning transfer. Students' learning should be meaningful; however, their learning styles are different. Not all learners' acquisition and meaning-making processes happen through language and speech. Mostly, ESAP courses do not consider different modes that interact in the process of meaning-making. Based on the knowledge-construction view, multimodal learning is an activity of sense-making in which students try to build "a coherent mental representation from the presented material" (Mayer, 2009, p. 17) that is called understanding (vs. remembering). Understanding is the ability to employ the presented material in new situations (i.e., transfer). Therefore, meaningful learning can be distinguished by "good transfer performance as well as good retention performance" (Mayer, 2009, p. 21). A multimodal method of teaching that presents material in audio-visual modes can facilitate explanation, comprehension, investigation, and learning participation (Papageorgiou & Lameras, 2017). It can help learners obtain a nuanced comprehension of the subject-matter content, improve the understanding of print-based text, and transfer the acquired knowledge more productively (Choi & Yi, 2016). Thus, multimodal teaching practices can enhance learners' sense of accomplishment (Sun et al., 2021) and help them engage in learning.

Several studies have covered different aspects of ESAP in Iran. These studies investigated, including English academic writing (e.g., Eslami, 2010), learning

transfer and LTSI (e.g., Ataei & Zamani, 2018; Shooshtari et al., 2017), the effect of multimodality in reading comprehension skills (e.g., Boshrabadi & Biria, 2014). However, few studies have investigated multimodality in an ESAP writing course (e.g., Haghighi et al., 2019; Shooshtari et al., 2018), and no study has taken into account teaching for transfer in discipline-specific academic writing of graduate engineering students through multimodal instruction and collaboration.

Given the above-mentioned concerns, this study attempted to examine an approach toward teaching discipline-specific writing practices for four engineering majors through collaboration and multimodal instruction at Ferdowsi University of Mashhad, assuming that the process of skill development and learning transfer would be both facilitated and actualized for the graduate engineering students. Accordingly, the following research questions were raised:

1. To what extent does the collaborative multimodal input facilitate the process of learning transfer in Iranian graduate students of engineering?

2. To what extent do learners' perceptions of the LTSI learning-specific and learning-general constructs reveal the catalysts and barriers of learning transfer in academic writing practices?

2. Literature Review

2.1. Academic Writing and English for Academic Specific Purposes

Academic writing can enhance students' analytical skills and creativity. It can help them think objectively and develop their presentation skills. It also enables other people to understand what students think (Ibrahim et al., 2017). English for academic purposes contains instruction and research about individuals' requirements and practices in the academic context. Arianmanesh and Khani (2019) compared the actual and the perceived academic writing competence of Iranian graduate students enrolled in EAP courses. They found that the students' perceptions of their academic practices are significantly different from their actual practices across their academic fields of study. According to Zeidmane and Cernajeva (2011), sometimes learners do not realize the need for these competencies since they have a negative experience of foreign language learning from their background education. They recommended the use of Content and Language Integration Learning (CLIL) method in the study process of engineering education to develop professional foreign language skills. Dehghan and Razmjou

(2012) studied writing strategies used by the Iranian graduate students while writing discipline-specific tasks. They concluded that socio-affective, resourcing, and communication strategies were utilized more than the cognitive strategies. In addition, they found that the metacognitive strategies were ignored as a result of not being aware of the specific writing genres of the field.

To prepare students to achieve their professional recognition through writing, ESAP courses should have a clear purpose: to facilitate students' successful navigation through an academic program in their given discipline (James, 2010). To actualize this goal, students need to apply what they have acquired beyond such ESAP courses; in other words, they should transfer their acquisition, which involves prior learning influencing new performance or learning (Marini & Genereux, 2013). Thus, ensuring that the ESAP instruction ends in such learning transfer is an important concern.

2.2. Learning Transfer

One of the central goals of education is the transfer of learning-applying previous learning to a new context (Green, 2015). In an ESL writing course, the reason for not transferring the learned material might be a mismatch between the type of writing tasks in an ESL writing course and the type of tasks students are expected to write in their academic courses. This difference can make it difficult for them to transfer learning outcomes from the ESL learning course; thus, they need help to bridge the difference (James, 2009; Sulaiman & Zhao, 2023). Shooshtari et al. (2018) investigated the way graduate students majoring in medical sciences and learning ESAP assess the four constructs in LTSI, including ability, motivation, working environment, and trainee characteristics that facilitate learning transfer in discipline-specific academic writing programs. They found that more consideration of work-related factors is needed in higher education in order to enhance the transfer of writing outcomes. LTSI "is an empirically derived self-report 16-factor inventory designed to assess individual perceptions of catalysts and barriers to the transfer of learning from work-related training. Transfer of learning is the capability to move from pre-training experiences to the application of learning to tasks and beyond those that were initially targeted by the training" (Bates et al., 2012, p.549). Based on this definition of transfer of learning, it can be argued that this capability needs to be fostered in students who participate in an ESAP course.

According to James (2014), the similarity between the instructional situation and

the authentic practice of the task can influence language transfer; therefore, the collaboration between language and specialized teachers to provide a context similar to the discipline-specific context can help learning transfer.

2.3. Collaborative Syllabus Design

ESAP instructors do not have a wide understanding of the writing that students need to write for their content courses. As a result of this limited understanding, collaboration between the EASP instructor and the discipline-specific instructors would be beneficial (Bhatia, 2014). As Zeidmane and Cernajeva (2011) believe, it is essential to employ an interdisciplinary approach in engineering education to increase the necessary competencies for engineers. According to Borrego and Newswander (2010), in science and engineering, faculty members see interdisciplinary research as a cooperative process and structure learners' learning experiences accordingly.

Collaborative curriculum fosters active acquisition and develops reflection. Instructors work together to create syllabi and materials (Drits-Esser & Stark, 2015). Language lecturer needs to comprehend the major concern of the subject prior to developing an effective language-learning syllabus (Stewart, 2018). Teachers in collaborative design teams create new curricular materials such as lessons or courses in cooperation with one another and perhaps with experts from the educational research, design, and content domains (Dendenne, 2021). Voogt et al. (2011) employed the Interconnected Model of Professional Growth proposed by Clarke and Hollingsworth (2002) to identify teacher learning practices during collaborative effort. They analyzed and published studies from different countries considering teachers' collaborative curriculum design. They concluded that the Interconnected Model of Professional Growth was identified to recognize the learning process both in individual teachers initially and in teams of teachers collaboratively designing a curriculum.

Even collaboratively designed ESAP courses may not consider different modes that interact in the process of meaning-making. Based on the knowledge-construction view, multimodal learning is an activity of sense-making in which students try to build "a coherent mental representation from the presented material" (Mayer, 2009, p.17). Thus, incorporating multimodality in syllabus design seems to be a necessity.

2.4. Multimodality

Focusing on language as the basic mode of instruction can represent a partial role in

communicating and transferring the material in the classroom (Jewitt, 2012). Mayer (2009) stated that the learning would be more comprehensive and meaningful if the resources and the tools were interactively employed. There is a "transitional shift from print-based education to multimodal education" (Papageoria & Lameras, 2017, p.133). This highlights the necessity of reconsidering the way learning and teaching are practiced and convinced. Multimodal teaching facilitates explanation, comprehension, investigation, and learning participation (Papageoria & Lameras, 2017). Considering academic writing as a need for students, notably for graduate students (Bailey, 2011; Swales & Feak, 2012), multimodal pedagogy as a facilitative approach, and learning transfer as a significant issue in ESAP classes, this study attempted to provide graduate engineering students moments of meaning-making through a collaborative multimodal writing instruction and practice.

3. Methodology

3.1. Participants

In collaboration with Ferdowsi University of Mashhad, ESAP writing courses were presented for every discipline separately. Sixty male and female graduate engineering students (age range 23-40) from four disciplines attended these courses voluntarily. The number of participants varied in each group: 18 mechanical, 11 civil, 20 computer, and 11 electrical engineering students. They were PhD and master students who were in different years of their studies. Prior to the study, all participants had completed a three-credit course of general English, which generally aimed to provide practice in reading and translation skills. Subsequently, they were required to pass another four-credit discipline-specific English course that aimed to enable students to read and comprehend discipline-specific texts and use scientific English sources. Accordingly, it was assumed that participants were relatively ready to take a writing course in English. Considering the emphasis of this study on writing practices, engineering students could voluntarily participate in the courses regardless of their general English proficiency levels.

3.2. Materials

Materials for each session of instruction were adopted from four academic writing textbooks written by Bailey (2011), Beer and McMurrey (2014), Berger (2014), and Swales and Feak (2012). These books were selected considering the relevance of their content to the context of this study. Furthermore, the authors of the books

acknowledged that the sources were developed to meet the academic writing needs of graduate nonnative learners. The books were chosen after consulting two English academic writing experts. They contained writing tasks that students needed to complete throughout their education and later career. The chapters involved materials that prepare learners for professional writing, such as articles and dissertation submissions. They also emphasized the rhetorical aspects of writing for the engineering field. Some parts of each book were selected according to the goal of each session after consulting two experienced content lecturers of every discipline.

During the instruction program, multimodality through audio and visual modes was practiced in the form of video clips. The video excerpts related to the selected topics of the writing tasks were put on display, and since not all students appreciate audio-visual input or perhaps, they still require more information, a written text covering the same topic was presented to the participants. Diverse discipline-specific writing models were instructed, exemplified, and practiced. However, the focus was on the tasks and models presented in the aforementioned academic writing books. They included abstracts, justification of claims in arguments, argumentation of premises, specifications, reports, instructions, and research paper structures. The video clips, writing topics and tasks, and written texts were selected after consulting content lecturers of each discipline.

3.3. Data Collection Instrumentation

Data was collected through the following measures: pretest of writing skills, instruction of academic discipline-specific writing skills, posttest of writing skills, and delayed posttest of authentic writing skills, and the LTSI questionnaire.

3.3.1. Pretest of writing skills

To check the level of participants' awareness of the basic and essential models of writing for their disciplines, pretests of writing skills were conducted for each discipline in classes. Participants were supposed to write an argument about the discipline-specific topic suggested by the content lecturers. The video excerpts related to the topic in focus were also displayed. In addition, a text covering the same topic was shown. The participants were given 30 minutes to complete the task and deliver their argument paragraphs to the language lecturer. The selected writing

outcomes, based on James's (2009) scale, were used by the researchers as a reference to score the test results.

One of the researchers scored the paragraphs. The consistency of assessment was checked by inviting another experienced EFL writing researcher to score 20% of the test papers using James' (2009) checklist of 15 writing outcomes that target three categories organization (including using a conclusion, logical sequence, cueing statements, connectives and cohesive devices, introducing the topic, and following the rhetorical pattern in focus), content (including describing, exemplifying, comparing/contrasting, defining, and classifying), and finally language use (including avoiding missing commas after introductory elements, avoiding fused sentences, and avoiding sentence fragments). To assess the use of each of these learning outcomes, James (2009) developed a four-point scale (i.e., 0 = no use of learning outcome; 1 = minimal use of learning outcome; 2 = moderate use of learning outcome; 3 = extensive use of learning outcome). For example, for the learning outcome using cueing statements, a point 3 meant that cueing statements were used regularly and they were functional and explicit. A point 2 indicated that cueing statements were used everywhere they could be, but they were not always substantive and explicit. A point 1 indicated that cuing statements were used, but, in some places, they were missing. Finally, a point 0 indicated that no identifiable cueing statements were used. The raters independently scored each of the argument paragraphs for the employment of the 15 learning outcomes and calculated the sum for each argument. The researcher's decisions (as the first rater) were compared to the other rater's scoring decisions and inter-coder reliability was calculated using Pearson correlation coefficient ($r = 0.841$, $n = 12$, $p < 0.01$).

To check the validity of the scoring procedure, the construct validity of James's (2009) checklist of writing outcomes was established through the employment of a differential-groups experiment procedure proposed by Brown (2005). In order to show the construct validity of a measurement instrument based on this procedure, the instrument could be employed to assess the ability it claims on two different groups. One group "obviously has the construct that is being measured and another that clearly does not have it" (Brown, 2005, p. 227). If the group, which had the construct, scored high on the test, while the other group scored low, it could be concluded that the measurement instrument is assessing what it is supposed to measure and hence it is valid. Accordingly, in order to show the construct validity of the James's check list in this study, it was applied to two different groups (an undergraduate group and a

graduate group of engineering students other than the participants of the treatment program) whose performances on what the checklist measures appeared to be different, because graduate students enjoyed more experience regarding their background in map projects and reports that were partly in English. A discipline-specific topic was assigned to these two different groups, each consisting of 30 participants selected randomly by the content lecturers. The writing outcomes of the two groups were scored using James's (2009) scoring schemes, and then an independent t-test was run on the results. There was a significant difference between the mean scores of the first group (M = 1.28, SD = 0.42) and the second group [M = 2.06, SD = 0.44; t (58) = 6.95, p = 0.00].

3.3.2. Treatment sessions

For the purpose of this study, 16 training sessions were designed for each discipline with the aim of instructing, practicing, and testing the selected writing tasks and skills through multimodal inputs. Two-hour treatment sessions were held twice a week by the language lecturer. The discipline-specific writing tasks (abstracts, justification of claims in arguments, argumentation of premises, specifications, reports, instructions, and research paper structures) and disciplinary genres (arguments and expositions) proposed by Beer and McMurrey (2014) and Berger (2014), were introduced, exemplified, and analyzed through audio-visual aids (video clips). Other elements of writing including cause and effect, comparison, generalizations, and problems and solutions were also introduced and exemplified. Language issues and accuracy in writing including lexis, grammar, cohesion, and coherence were instructed and practiced based on the elements proposed by Bailey (2011), Berger (2014), and Swales and Feak (2012). The sessions of writing instruction and practice were held separately for each group of the participants from the beginning to the end of the program.

During the practice sessions, a novel topic, recommended by the content lecturer, was introduced. Surfing the internet, the language instructor chose three video clips and sent them to the content lecturer to select one on the basis of relevance, comprehensibility, and novelty. The participants watched the chosen video and it was replayed when they asked for more exposure. Considering that not all the participants may appreciate audio-visual input, a written text covering the same topic was presented to them. The text was not meant to be an exact transcription of the video excerpt;

instead, it explained the topic in further technical details. The text was displayed in a limited time, long enough to ensure that learners read it completely; however, it was closed after the due time so that the students could not copy the sentences and use them directly in their final writing tasks of the session. After ensuring that participants were ready to begin their writing practice, they started writing the task within 30 minutes. They were supposed to write arguments and expositions about the topics proposed by the content lecturers. The written tasks were checked and returned to the participants a session later. Each mentioned step was repeated for all the practice sessions to the end of the semester.

3.3.3. Posttest of writing skills

To check the participants' achievements after the discipline-specific writing instruction, a posttest parallel to the pretest was administered for every discipline. The steps taken for choosing the topic and administrating the test were the same as the steps in the pre-test. The participants were required to write an argument about a discipline-specific topic suggested by the content lecturers. To check the test reliability (r = 0.939, n = 12, p < 0.01) and construct validity (t (58) = 11.93, p = 0.00), the same procedures as in the pre-test session were followed.

3.3.4. Delayed posttest

To scrutinize the participants' ability to successfully actualize their learning from the multimodal instruction to authentic domain-specific contexts, a delayed posttest of writing, similar to those of pre- and post-tests, was administered with a month interval after the instruction phase. Participants were required to write an argument about a discipline-specific topic recommended by the content lecturers. This session is distinguished from the other testing sessions considering the fact that it was conducted in participants' disciplinary classes with the collaboration of content lecturers. Hence, the context would resemble a professional setting where practice and test of the learning transfer could be more genuine. The test reliability (r = 0.867, n = 12, p < 0.01) and construct validity (t (58) = 11.28, p = 0.00) were checked following the same procedures as in the pre-test session.

3.3.5. LTSI questionnaire and focus group interview

This questionnaire investigates individual perceptions of barriers and catalysts to

the transfer of learning developed by Bates et al. (2012). It is a five-point Likert-type scale inventory ranging from one (strongly disagree) to five (strongly agree). All the answers were compiled to calculate the mean scores for each factor, in a range of 1 to 5. In effect, mean scores below 2 are deemed extremely negative, between 2 and 2.4 are negative, 2.5 to 3.4 are neutral, and 3.5 to 4 are positive, and above 4 are extremely positive (Table 1). It contains four factors: motivation, work environment, ability/enabling, and trainee characteristics or secondary influences. The first part of the questionnaire has 11 factors representing factors affecting the training program (training-specific scales). The second section is supposed to measure five factors categorized as general factors since they are assumed to influence all training programs (training-generals scales) (Zamani et al., 2016). Zamani et al. (2016) used the Persian translation of LTSI in agricultural sustainability learning in Iran. They attempted to examine the internal structure and predictive ability of Persian inventory. The findings of their study demonstrated that the Persian translation has both internal and predictive validity and can be employed either as a diagnostic tool or as an evaluative tool of the needs of the existing learning program. However, to validate the LTSI to the context of this study, the questionnaire was piloted with 60 students majoring in engineering. The data was sent to the inventory owners and all the estimates were calculated and accordingly a validated LTSI appeared suited with the purpose and the settings of this study that was used in process of data collection in each assumed discipline. To establish the internal consistency of the version four of the Learning Transfer System Inventory (LTSI), Chronbach's Alpha was run on the results obtained from a pilot study on 60 students of engineering. The actual value for Cronbach's alpha was 0.805, which indicated a high level of internal consistency.

Table 1 demonstrates how the obtained mean score for each factor was verbalized in the results column according to Donovan et al. (2001).

Table 1

Interpretation of LTSI Factor Scores

Factor score	Results
1-2	Extremely negative
2-2.4	Negative
2.5-3.4	Neutral
3.5-4	Positive
>4-5	Extremely positive

A focus group interview followed the questionnaire and were designed according to the transfer studies on writing instruction conducted by James (2010, 2012). The 12 questions chiefly revolved over the students' evaluations of the treatment they had received. The interviewer (the language lecturer of the training session) pursued to learn whether the participants believed their learning had transferred or not, whether they found the instruction influential, how much they were motivated to transfer in similar instances, and what were the debilitating factors they encountered and needed to be addressed more cautiously. The questions were open-ended, allowing new ideas to be brought up during the group discussion as a result of what the interviewees said so that the notions that could be overlooked in the questionnaire would evolve; in this manner, the responses were suited for a truly qualitative, exploratory research.

3.3.6. Data analysis

To answer the first research question the mean scores obtained from the three tests were compared through ANOVA. Regarding the second research question, the LTSI results were analyzed to see how each group of students with specific set of perceptions were impeded or facilitated by the encompassed factors to transfer the instructed skills. To analyze focus group interview data, the data analysis used by James (2010, 2012) was followed. Participants' answer to interview questions was coded as 'yes' (i.e., the participant's response was positive), 'no' (i.e., the participant's response was negative), or 'mixed' (i.e., the participant's response was positive and negative; for example, in X situation yes, but in Y situation no). The explanations that were given by participants for any question were identified and coded into categories.

In designing the collaborative ESAP syllabus, the new topics for writing tasks were chosen in consultation with the sub-discipline subject lecturers; that is, the chosen topics in a way were different and new across engineering sub-disciplines. Accordingly, the researchers found it informative to compare the performance of participants from pretest to posttest across the four sub-disciplines; this way, the overall rate of transfer can be traced not only among the participants of the broad discipline of the engineering field but also across the groups of sub-disciplines. Furthermore, the results may probably highlight the impact of discipline-related topics on handling the writing tasks on the rate of transfer from the instruction program to that of authentic writing tasks.

4. Results

To investigate the overall effect of a collaborative multimodal instruction on learning transfer of the English academic writing skill, the possible variance was examined from pretest to posttest and ultimately to delayed posttest. To this end, the mean scores obtained from three exams were compared through ANOVA. Table 2 summarizes the average scores of the participants in pretest and posttest, and delayed post-test sessions.

Table 2

The Descriptive Statistics of Performance on Pre, Post and Delayed Posttest

Disciplines	Mean			Std. Deviation			Variance		N
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Mechanical Engineering	1.34 2.65		2.63	0.31	0.23	0.22	0.1 00.05 18	0.05	
Civil Engineering	1.64	2.72	2.71	0.39 0.15	0.2		0.15	0.04	0.21 11
Computer Engineering	1.49	2.80	2.81	0.36 0.13	0.09		0.17	0.01	0.03 20
Electrical Engineering	1.29	2.66	2.65	0.46 0.22	0.22		0.19	0.05	0.03 11

*1 stands for pretest, 2 for posttest, and 3 for delayed posttest.

According to Table 2, the overall mean scores of all the four groups of participants increased from the pre-test to both the post-test and the delayed post-test. Mechanical and computer engineering students obtained higher mean scores in the delayed post-test. The total mean scores of the civil and electrical engineering groups reduced slightly from the post-test to the delayed post-test.

Subsequently, an ANOVA was run to pinpoint any meaningful difference between the participants' performances on the pretest, the posttest, and the delayed posttests. Table 3 sums up the results of each group's performance.

Table 3

ANOVA: Comparison of Groups' Mean Scores on Pre, Post, and Delayed Posttests

Disciplines	df	Eta Squared	F	Sig.
Mechanical Engineering	2	.96	218.375	.000
Civil Engineering	2	.97	150.154	.000
Computer Engineering	2	.95	171.923	.000
Electrical Engineering	2	.94	84.145	.000

As Table 3 indicates, there were statistically significant differences between the three sets of tests for the four groups of mechanical Engineering (F(2)= 218.375, p<.0005, multivariate partial eta squared= .96), civil Engineering (F(2)= 150.154, p<.0005, multivariate partial eta squared= .97), computer Engineering (F(2)= 171.923, p<.0005, multivariate partial eta squared= .95), and electrical Engineering (F(2)= 84.145, p<.0005, multivariate partial eta squared=.94). Post hoc analysis with a Bonferroni adjustment revealed a statistically significant difference between the pre-test and the post-test (civil: *M* = 1.685, computer: *M* = 1.313, electrical: *M* = 1.370, mechanical: *M* = 1.289, CI = 95%, p < .05), and between the pre-test and the delayed post-test (civil: *M* = 1.673, computer: *M* = 1.317, electrical: *M* = 1.364, mechanical: *M* = 1.307, CI = 95%, p < .05), but not between the post-test and the delayed post-test (civil: *M* = 0.012, computer: *M* = 0.003, electrical: *M* = 0.006, mechanical: *M* = 0.019, CI = 95%, p < .05). These findings demonstrated that the academic writing skills of the four groups of participants significantly improved and they meaningfully transferred the acquired skills to the authentic academic settings. Using the commonly used guidelines proposed by Cohen (1988) (.01= small, .06= moderate, .14= large effect), the Partial Eta squared scores obtained in this study (mechanical engineering= .96, civil engineering= .97, computer engineering= .95, and electrical engineering= .94) suggested a very large effect size.

To discern which constructs or factors obstructed or accelerated the transferring and learning processes, the results of the sixteen factors of the LTSI were analyzed to notice how each group of learners with specific set of perceptions were facilitated or hindered by the included factors to transfer the acquired skills. The mean scores of the reported constructs for each group were summarized in Tables 4, 5, 6, and 7.

As the Tables displays, in spite of the fact that there are some dissimilarities between groups with regard to some factors, noticeable similarities existed particularly with respect to motivation and ability constructs where students' perceptions indicated almost the same values. Trainee characteristics construct was the next construct that showed some level of similarity between groups. Work environment factors differed widely between groups.

Table 4

Mean Scores of the Reported LTSI Factors Based on the Mechanical Engineering Students' Perceptions

Mechanical				
Constructs	Factors	Mean scores	Results	Comments
Ability	Transfer design	4.16	Extremely Positive	To a certain extent, training enabled students to apply learning to professional settings and the instruction complemented university requirements.
	Content validity	3.61	Positive	It suggests that the instructional content clearly reflected university requirements.
	opportunity to use	3.85	Positive	It indicates that the students were provided with resources and practices which enabled them to use learned skills.
	Personal capacity	3.01	Neutral	This suggests that the students did not usually have the time, energy, and mental space in their work lives to make prerequisite changes to transfer learning to their professional settings.
Motivation	Transfer effort performance expectations	4.33	Extremely Positive	Students strongly believed that effort devoted to transferring learning would lead to changes in work-related performances.
	Performance outcome expectations	4.14	Extremely Positive	Students believed that improvements in career performance would yield valuable outcomes.
	Motivation to transfer	3.80	Positive	Students show some tendency, concentration and persistence in utilizing learned skills and knowledge.
	Personal outcome negative	2.87	Neutral	Students believed that failure to apply new skills and learning would not be noticed or result in negative outcomes for themselves.
	personal outcome positive	3.15	Neutral	Students believed that improvements in career performance would yield valuable outcomes.
Work environment	Supervisor support	3.18	Neutral	It means that specialized lecturers did not usually react negatively to the use of new skills, knowledge or techniques by the students.
	Performance coaching	3.91	Positive	It indicates that individuals clearly receive feedback, instruction or performance indicators from the people in their workplace.
	Peer support	3.42	Neutral	Classmates usually reinforced and supported use of learning. They show some patience and appreciation when new skills and techniques are tried and used.
	Resistance to change	2.46	Negative	Students did not perceive their workgroup to be open to, supportive of and willing to invest effort in change and to try new ways of doing things.

	Supervisor sanction	2.18	Negative	It means that specialized lecturers react negatively to the use of new skills, knowledge, or techniques by the students.
Trainee characteristics	Learner readiness	3.68	Positive	In general, students were prepared for training. Prior to training, they know what to expect or how training was related to their academic development.
	Performance self-efficacy	3.61	Positive	Students were self-confident and believed in their own ability to change their performance if they wanted to overcome obstacles that hindered the use of new learning.

Table 5

Mean Scores of the Reported LTSI Factors Based on the Civil Engineering Students' Perceptions

		Civil		
Constructs	Factor	Mean scores	Results	Comments
Ability	Transfer design	3.35	Neutral	To a certain extent, training might enable students to apply learning to professional settings and the instruction complemented university requirements.
	Content validity	3.75	Positive	It suggests that the instructional content clearly reflected university requirements.
	Opportunity to use	3.52	Positive	It indicates that the students were provided with resources and practices which enabled them to use learned skills.
	Personal capacity	2.60	Neutral	This suggests that the students did not usually have the time, energy, and mental space in their work lives to make prerequisite changes to transfer learning to their professional settings.
Motivation	Transfer effort performance expectations	4.15	Extremely positive	Students strongly believed that effort devoted to transferring learning would lead to changes in work-related performances.
	Performance outcome expectations	3.62	Positive	Students believed that improvements in career performance would yield valuable outcomes.
	Motivation to transfer	3.72	Positive	Students show some tendency, concentration and persistence in utilizing learned skills and knowledge.

		Civil		
	Personal outcome negative	2.75	Neutral	Students believed that failure to apply new skills and learning would not be noticed or result in negative outcomes for themselves.
	personal outcome positive	4.12	Extremely Positive	Students saw positive outcomes as a result of applying new skills and learning in professional settings.
Work environment	Supervisor support	2.60	Neutral	It means that specialized lecturers did not usually react negatively to the use of new skills, knowledge or techniques by the students.
	Performance coaching	3.5	Positive	It indicates that individuals clearly receive feedback, instruction or performance indicators from the people in their workplace.
	Peer support	3.42	Neutral	Classmates usually reinforce and supported use of learning. They showed some patience and appreciation when new skills and techniques were tried and used.
	Resistance to change	2.33	Negative	Students did not perceive their workgroup to be open to, supportive of and willing to invest effort in change and to try new ways of doing things.
	Supervisor sanction	1.75	Extremely negative	It means that specialized lecturers react negatively to the use of new skills, knowledge, or techniques by the students.
Trainee characteristics	Learner readiness	3.75	Positive	In general, students were prepared for training. Prior to training, they know what to expect or how training was related to their academic development.
	Performance self-efficacy	3.63	Positive	Students were self-confident and believed in their own ability to change their performance if they wanted to overcome obstacles that hindered the use of new learning.

Table 6

Mean Scores of the Reported LTSI Factors Based on the Computer Students' Perceptions

		Computer		
Constructs	Factor	Mean scores	Results	Comments
	Transfer design	3.59	Positive	To a certain extent, training enabled students to apply learning to professional settings and the

		Computer		
				instruction complemented university requirements.
Ability	Content validity	4.10	Extremely Positive	It suggests that the instructional content clearly reflected university requirements.
	Opportunity to use	3.66	Positive	It indicates that the students were provided with resources and practices which enabled them to use learned skills.
	Personal capacity	2.54	Neutral	This suggests that the students did not usually have the time, energy, and mental space in their work lives to make prerequisite changes to transfer learning to their professional settings.
Motivation	Transfer effort performance expectations	3.92	Positive	Students believed that effort devoted to transferring learning would lead to changes in work-related performances.
	Performance outcome expectations	3.60	Positive	Students believed that improvements in career performance would yield valuable outcomes.
	Motivation to transfer	3.72	Positive	Students show some tendency, concentration and persistence in utilizing learned skills and knowledge.
	Personal outcome negative	3.10	Neutral	Students believed that failure to apply new skills and learning would not be noticed or result in negative outcomes for themselves.
	personal outcome positive	3.60	Positive	Students saw positive outcomes as a result of applying new skills and learning in professional settings.
Work environment	Supervisor support	3.23	Neutral	It means that specialized lecturers did not usually react negatively to the use of new skills, knowledge or techniques by the students.
	Performance coaching	3.83	Positive	It indicates that individuals clearly receive feedback, instruction or performance indicators from the people in their workplace.
	Peer support	3.20	Neutral	Classmates usually reinforce and supported use of learning. They showed some patience and appreciation when new skills and techniques were tried and used.
	Resistance to change	2.71	Neutral	In general, students did not perceive their workgroup to be open to, supportive of and willing to invest effort in change and to try new ways of doing things.

		Computer		
Trainee characteristics	Supervisor sanction	1.78	Extremely negative	It means that specialized lecturers react negatively to the use of new skills, knowledge, or techniques by the students.
	Learner readiness	3.58	Positive	In general, students were prepared for training. Prior to training, they know what to expect or how training was related to their academic development.
	Performance self-efficacy	3.69	Positive	Students were self-confident and believed in their own ability to change their performance if they wanted to overcome obstacles that hindered the use of new learning.

Table 7

Mean Scores of the Reported LTSI Factors Based on the Electrical Students' Perceptions

		Electrical		
Constructs	Factor	Mean score	Results	comments
Ability	Transfer design	3.69	Positive	To a certain extent, training enabled students to apply learning to professional settings and the instruction complemented university requirements.
	Content validity	3.58	Positive	It suggests that the instructional content clearly reflected university requirements.
	Opportunity to use	3.86	Positive	It indicates that the students were provided with resources and practices which enabled them to use learned skills.
	Personal capacity	3.15	Neutral	This suggests that the students did not usually have the time, energy, and mental space in their work lives to make prerequisite changes to transfer learning to their professional settings.
Motivation	Transfer effort performance expectations	4.08	Extremely positive	Students strongly believed that effort devoted to transferring learning would lead to changes in work-related performances.
	Performance outcome expectations	3.73	Positive	Students believed that improvements in career performance would yield valuable outcomes.
	Motivation to transfer	3.68	Positive	Students show some tendency, concentration and persistence in utilizing learned skills and knowledge.

		Electrical		
	Personal outcome negative	2.84	Neutral	Students believed that failure to apply new skills and learning would not be noticed or result in negative outcomes for themselves.
	personal outcome positive	4.06	Extremely positive	Students saw positive outcomes as a result of applying new skills and learning in professional settings.
Work environment	Supervisor support	3.21	Neutral	It means that specialized lecturers did not usually react negatively to the use of new skills, knowledge or techniques by the students.
	Performance coaching	3.04	Neutral	It indicates that individuals usually receive feedback, instruction or performance indicators from the people in their workplace.
	Peer support	3.39	Neutral	Classmates usually reinforce and supported use of learning. They showed some patience and appreciation when new skills and techniques were tried and used.
	Resistance to change	2.60	Neutral	In general, students did not perceive their workgroup to be open to, supportive of and willing to invest effort in change and to try new ways of doing things.
	Supervisor sanction	1.93	Extremely negative	It means that specialized lecturers react negatively to the use of new skills, knowledge, or techniques by the students.
Trainee characteristics	Learner readiness	3.18	Neutral	In general, students were not sufficiently prepared for the training. Prior to training, they partially know what to expect or how training was related to their academic development.
	Performance self-efficacy	3.75	Positive	Students were self-confident and believed in their own ability to change their performance if they wanted to overcome obstacles that hindered the use of new learning.

To have a better understanding of the participants' perceptions of the transfer facilitators and inhibitors, focus group interviews were administered immediately after the delayed post-tests. The interview questions were designed based on James' (2010, 2012) transfer studies on writing instruction. The questions chiefly revolved over the students' evaluations of the treatment they had received. The interviewer (the language lecturer of the training session) pursued to learn whether the participants believed their learning had transferred or not, whether they found the

treatment influential, how much they were motivated to transfer in similar instances, how much the work environment supported their learning transfer, and what were the debilitating factors they encountered and needed to be addressed more cautiously. The information derived from the interviews revealed participants' perceptions toward the transfer of their received instruction. Table 8 summarizes the participants' perceptions.

Table 8

Participants' Perceptions in Focus Group Interview

Focus group interview questions	Number of participants		
	Yes	No	Mixed
Besides the ESAP course, what courses are you taking this semester? Do they involve any kind of writing?	41	19	0
Have your English writing skills improved in ESAP this semester? If so, what has improved?	39	1	20
Do instructors in your other courses expect students to have strong English writing skills?	46	0	14
Do instructors in your other courses provide feedback on students' English writing skills?	10	18	32
Do or would instructors in your other courses react positively to your use of skills learned and practiced in ESAP course?	25	7	28
Do your classmates have positive attitudes toward English writing courses?	18	9	33
Do your classmates encourage students to transfer learning outcomes from English writing courses to those courses?	12	8	40
Do you think using skills that you learn and practice in ESAP can help you to get higher grades in other courses?	32	10	18
Do you think using skills that you learn and practice in ESAP can help you to work faster in other courses? Why or why not?	48	6	6
Have you used anything that you have learned or practiced in the ESAP course in your other courses this semester?	40	11	9
Is it important to you that you use things you have learned or practiced in the ESAP course in other courses? Why or why not?	44	7	9
Do you make an effort to use things you have learned or practiced in the ESAP course in other courses? Why or why not?	55	0	5

The focus group interview results revealed that the majority of the participants of the four groups had a kind of academic written work in their specialized courses. The participants reported that their English writing skills improved in the ESAP course this semester. They also attempted to apply what they had learned in the ESAP writing course to their disciplinary writing tasks. The participants thought

using the skills that they had learned and practiced in the ESAP writing course could help them get higher grades and work faster in other courses. It was important to them to use things they had learned or practiced in the ESAP course in their other courses. The participants also emphasized that they will make an effort to use things they had learned or practiced in the ESAP course in their discipline-specific courses.

Considering specialized instructors' support for transfer, the participants stated that their specialized instructors expected them to have strong English writing skills. They reported that overall, the instructors of their other courses had positive attitudes toward English writing courses; however, they do not have enough time to be involved in identifying opportunities to apply new skills and knowledge or setting realistic goals based on the ESAP training. Furthermore, they do not work with students on problems encountered while applying new skills or providing feedback when the students successfully apply new abilities.

Considering classmates' support for transfer, generally, the participants were neutral about their classmates being concerned about English writing skills and their encouragement to transfer learning outcomes from English writing courses to discipline-specific courses. The participants reported that most of their classmates were not aware of the participants' attendance in the ESAP course. Furthermore, the huge work load of professional and educational duties hindered participants and their classmates to discuss about the ESAP course.

5. Discussion

The present study explored the influence of multimodality and collaboration in discipline-specific academic writing teaching on learning transfer of engineering graduate students. Moreover, the study sought to inspect the students' perceptions towards the impeding or facilitating work-related factors for transferring their acquired knowledge or skills.

Overall, the results of the first research question indicated that the impact of an integrated bridging ESAP writing course for graduate engineering students allowed them to improve the structure and organization of their writing from pre to post training. The findings of this research supported James' (2014) view that the degree of similarity between instructional situation and authentic practice of the task can affect language transfer. Collaboration to create a context similar to the discipline-

specific context, as Archer et al. (2014) emphasized, helped participants apply the acquired knowledge in later professional works. In line with 'transfer climate' concept suggested by James (2010), the environment was considered important in this research. This concept highlights the impact of the participants' perceptions of the present discourse and the skills they acquire in the transfer process. Whether learners have the opportunity to practice acquired skills or whether they feel that the learned skills are useful are examples of the transfer climate (Hill et al., 2020).

To master a learning task, discerning the objects of relevant aspects of learning in a way that facilities holistic and appropriate meaning making is necessary (Patron et al., 2017). The multi-representation approach displays information in different forms, making it simpler for learners to comprehend the subject matter in various modes (Rahman et al., 2021). Representational competence fosters learners' construction of mental models of concepts; thus, it is essential to consider this competence while developing instructional resources (Pande, 2017). Applying multimodality to the instruction phase of this study provided opportunities for the instructor to present the core content in different modes and cater for different learning styles of participants. In line with Moreno and Myer's (2007) study, this assisted ESAP participant in the process of meaning making and allowed them to transfer their knowledge to authentic writing tasks more effortlessly.

As the results of this study indicated, although there were some differences between groups considering students' perceptions of the reported LTSI factors, noticeable similarities emerged specially with reference to motivation and ability constructs where students' perceptions collided nearly the same values. Trainee characteristics construct was another construct that showed some level of similarity between groups. Work environment factors differed widely between groups. Overall, these findings suggested that the instruction program proceeded effectively and the students were eager to apply the learned knowledge and the new learning design. The analysis of the LTSI data indicated some positive and negative factors that constrained the act of learning transfer.

Considering the four groups of the students, nearly all the participants appeared to have the same conceptions over eleven out of sixteen factors comprised in the LTSI; these factors included three *ability,* three *motivation,* four *work environment,* and one *trainee characteristics* factors. About ability factors, the four groups positively appraised *content validity* and *opportunity to use,* and three groups

positively appraised *transfer design*. These findings implied that the design of the training, the provided recourses, and the instructional materials empowered the graduate engineering students to employ learned writing skills. Therefore, these three ability factors seemed to function as catalysts for the learners to transfer the academic writing abilities to their professional practices.

However, regarding the fourth common *ability* factor, *personal capacity*, almost all learners did not have a positive perception about having the time, energy, and mental space in their professional lives to make required changes to transfer their currently acquired skills. Heavy workloads and time pressures are main constraints to transfer process (Clarke, 2002). These factors may cause feelings of frustration which in turn affect learners' motivation to engage in higher academic practices (Shooshtari, et al., 2018). Hence, personal capacity might be considered as a learning transfer barrier to the regular use of the acquired skills. When the students doubt about being able to allocate sufficient time and practice, the newly learned skills and knowledge would gradually vanish in the long run as a result of not being employed.

Concerning *motivation* construct, the four groups exhibited *extremely positive or positive* attitude toward *transfer effort performance expectation, performance outcome expectation* and *motivation to transfer*. In other words, students strongly believed that effort devoted to transferring learning would lead to changes in work-related performances and the improvements in career performance would yield valuable outcomes. They showed some tendency, concentration and persistence in utilizing learned skills and knowledge. In educational psychology, researchers have considered motivation as an important influence on learning transfer (Pugh & Bergin, 2006; James, 2012). Students' determination and motivation to develop their academic communication leads them to take action outside of the learning environment to practice their skills (Arnó-Macià et al., 2020). Thus, these three motivation factors can be noticed as catalysts to the process of transfer in the present discipline-specific writing setting.

Focusing on conceptions related to *work environments*, the groups perceived four factors almost in the same way. Considering *supervisor support*, the four groups remained neutral and accepted that their specialized lecturers would not acknowledge the currently learned skills properly. Students' perceptions about *personal outcomes* (*negative)* factor were neutral which means that they doubted that failure to apply new skills would not result in negative outcomes for

themselves. In addition, related to *peer support*, students were not sure that their classmates reinforced and supported the use of their learning of ESAP course. Eventually, regarding the last common factor, *supervisor sanction*, almost all the participants held *negative* or *extremely negative* attitude toward the way specialized lectures would react to the use of new skills. Transfer climate consist of a combination of attitudes of support or lack of it for learning transfer from supervisors, and other stakeholders (Holton III et al., 2000). This support includes supervisors' encouragement to apply knowledge or skills from training in the workplace as well as their positive perceptions toward training and positive reactions when skills from training are applied in the workplace (James, 2010). According to Lim and Johnson (2002), one of the strongest factors affecting transfer in professional settings is a supportive climate between the supervisors and trainees. Thus, participants' negative assessment of supervisor reaction suggested that content lecturers' negative reactions toward the use of new techniques impedes the transfer of skill from study situation to new context

Performance coaching factor viewed positively by three groups which means they clearly received feedback and instructional indicators during the training program. Furthermore, among the work environment factors, *resistance to change* was appraised negatively by mechanical and civil students and neutral by computer and electrical students. This indicated that, while computer and electrical students were skeptical, mechanical and civil students disagree that their workgroup to be open to, supportive of and willing to invest effort in change and to try new ways of doing things, probably another barrier to learning transfer practices. The sense of usefulness of the received instruction and the practice of transfer can be related to the work-place reinforcement (Clarke, 2002). There exist some challenges in the process of the interdisciplinary collaboration between faculties in language learning and teaching units and those in the content departments in higher education which is at the core of a Writing Across the Curriculum approach to academic writing enhancement (Vrchota, 2015) ranges from a paucity of authorities and administrators' long-term financial commitment (Cox & Galin, 2020) to a lack of faculty support. It often displayed in "pseudo-compliance" or even "explicit rejection" (Davison, 2006, p. 466). In spite of such difficulties, some institutions have successfully initiated interdisciplinary collaboration (Adler-Kassner, 2019). Such collaborations can bring about "optimal conditions" for leaners to "rhetorical norms of their field" (Gilmore & Millar, 2018, p. 6).

Examining the constructs that comprised trainee characteristics, i.e., *learner readiness* and *performance self-efficacy*, all groups shared nearly similar perceptions (except for learner readiness assessed neutral by electrical students). Prior to training, they partially know what to expect or how training was related to their academic development. They were self-confident and believed in their own ability to change their performance if they wanted to overcome obstacles that hindered the use of new learning. However, the electrical students stayed doubtful about their readiness and inferred that they were skeptical about being sufficiently prepared for the training. Lower level of written proficiency of electrical engineering students compared to other groups could influence their attitudes of learning readiness and self-efficacy in their educational setting. Wolfe (2009), in a study of learners' perception toward academic skills, concluded that when learners feel demands on their workload and time, they would depreciate their proficiency.

6. Conclusion

Based on the finding of the present study, learning outcomes from an ESAP writing course can transfer to disciplinary writing practices. Giving learners authentic disciplinary samples to identify their organizations and structures extends learners familiar with the writing styles and elements of genres of their disciplines. Instructors should identify the most recent interdisciplinary teaching methods that can motivate learners to actively participate in completing the assigned tasks. In addition to students' skills, institutional conventions are also essential to more practical writing. Therefore, academic writing needs to be an integral part of the engineering studies curriculum and students should have access to sufficient and relevant references. Furthermore, work-related factors such as sufficient time and mental space can affect learning transfer. Considering ability factors and motivational factors, there can be an auspicious foundation for future educational planning if more disciplinary and institutional considerations are embraced.

The findings of this study may be practical for any university program for which the English academic writing skill is a prerequisite to producing well-developed texts for publication at higher education. However, considering the contextual factors of the present study, where English is considered as a foreign language, further researches in second language learning settings and in other disciplines seem necessary. In addition, the pre-test–post-test design employed in this study did not include a control group due to the limited number of existing students in the context

of the study. According to Salkind (2010), quasi-experimental pre-test–post-test studies may or may not include control groups. However, further researches that include control groups are needed to substantiate the results of the current study.

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