Developing an Instructional Model to Teach Thai Research Assistants to Write English Scientific Research Articles

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Abstract

Researchers in science working in non-English contexts have been found to have problems with publication of their research articles (RAs). This study sought to explore outline ways in which explicit instruction, also called Scholarly Writing Builder (SWB), the instructional model originally constructed with the aim to coach Thai research assistants to write for publication. In response to the problems observed in realistic Thai settings and occurring in the literature, the study resorted to a research-and-development design with three phases: surveying problems and needs, constructing the instructional model for effective use, and retesting the revised model for further actual use. Phase One initially explored the problems and needs of 125 Thai research assistants and researchers in 2009/2010. The participants revealed writing problems in sentences, paragraphs, essays, and various sub-skills for RA writing. Also, the research assistants showed stronger needs in developing their writing abilities than the researchers. These results informed construction of the model implemented in Phases Two and Three in 2011 (N=25) and 2012 (N=30), where science research assistants were taught to write RAs in their field. The findings drawn from these phases revealed that the participants could write their scientific RAs effectively as a result of being trained for academic writing through the instructional model. Their L1content was expressed in English more fluently from sentences to paragraphs to form their complete RAs. However, with awareness of RAs' generic features in their fields, they could write professionally despite some Thai linguistic patterns occasionally hindering English writing. The findings suggest that the SWB model resting on the participants' backgrounds and actual problems is of use to educators/researchers to develop scholarly-writing abilities of the apprentices working in non-English science institutes.

Keywords: instructional model, scholarly publication, problems in English scientific
        Writing, Thai research assistants

Introduction

In line with the importance of science and its related fields, the predominant role of English as the language for research publication has been observed (Blicblau, McManus, & Prince, 2009; Ferguson, 2007; Gosden, 1995; Tardy, 2004), and the need for sophisticated English writing ability for scholarly publication has thus been expanding (Cameron, 2007; Benfield, & Howard, 2000; Flowerdew, 1999a, 1999b; Li, 2002; Tychinin & Kamnev, 2005; Wang & Bakken, 2004). However, the manuscripts written by non-native writers have been found to deviate from the rhetorical conventions required in certain academic discourse communities. The difficulties these non-native writers encountered have been well documented as related basic language skills in general, and knowledge and ability associated with scholarly publication in particular, regardless of levels of areas of expertise—graduate students (Cho, 2004; Gosden, 2003), or scholars in the

fields (Flowerdew & Li, 2007; Lillis & Curry, 2006). As revealed by a number of studies (e.g., Cho, 2004; Curry & Lillis, 2004; Flowerdew,1999a, 1999b), the non-native scholars participating in these studies perceived themselves as ineffective due to their lower English proficiency having been labeled as a linguistic disadvantage. The serious, complex problems may explain why the participants in the studies by Flowerdew (2001), Gosden (2003), and Misak, Marusic, and Marusic (2005) failed to publish their research in English journals. As a result, non-native scholars resorted to two main solutions. The first approach was in the area of publication, where scholars sought disciplinary experts to help with scientific content and research methodology (see Li, 2007; Lillis & Curry, 2006). The ideas and comments obtained from these experts contributed to the quality of the manuscripts in terms of research knowledge for the community. The second approach that apprentices resorted to was associated with language resources taken from language experts (Lillis & Curry, 2006), published research articles (RAs) as examples (Gosden, 1995; Li, 2007; Lillis & Curry, 2006), and the use of style or language to be borrowed and adopted in their manuscripts (Li, 2007). These could explain the findings found in the studies by Flowerdew and Li (2007)—the manuscripts some non-native writers or scholars wrote were suspected with 'textual plagiarism' (Curie,1998) and refined through the service called a 'literacy broker,' the language specialist helping non-native scholars in the process of preparing their publication manuscripts (Lillis & Curry, 2006).

These difficulties were reported as the consequences happening to the non-native scholars with linguistic disadvantages (Cho, 2004; Curry & Lillis, 2004; Flowerdew, 1999a, 1999b) and documented as one of the major barriers the apprentice scholars encountered in their process of publishing their RAs. In the studies by Karans (2002) and Pérez-Llantada (2012), the manuscripts written by the writers with linguistic disadvantages were found to contain a number of flaws ranging from basic grammar, clause structures and academic expression to the use of language on a higher level, such as within the metadiscourse and pragmatics. On a macro level constituting RA organization, the manuscripts written by these writers deviated from the RAs with conventional rhetorical structure regularized by the members of academic discourses, and this may result in, once again, a large number of unsuccessful publications for international journals (Adnan, 2014; Flowerdew, 2008; Li, 2007, 2012; Lillis & Curry, 2006; Prior, 1998; Sheldon, 2011; Uzuner, 2008).

Although it is not unusual for non-native writers to have these problems in their writing due to its most complex nature (Dueraman, 2012; Glass, 2008), this issue creates a great impact on the studies that focus on the ways in which non-native writers write, most of which portray negative attitudes toward their written products. As a result, a number of scholars (e.g. Crookes, 1986; Hinkel, 2006; Miller, 1984; Moses, 1985; Pagel, Kendall, & Gibbs, 2002; Swales, 1981, 1987; Widdowson, 1983) support explicit instruction with emphasis on the language use for publication. Another suggestion is that this group of writers should be taught to write advanced sentence constructions. This is sensible as the writers should be aware that logical thoughts for writing are essential for thoughts to be translated into written communication on all levels, even a quite small one like sentence structures. As such, the explicit instruction emphasizing the schematic, rhetorical requirements of English RAs in science, regardless of learners' mastery of English grammar, should benefit these novice writers (Cameron, 2007; Cargill & O'Connor, 2006; Flowerdew,1999a, 1999b; Gosden, 1995; Li, 2006a, 2006b, 2007; Swales' 1990; Tychinin & Kamnev, 2005; Wang & Bakken, 2004).

However, these suggestions have rarely been implemented in empirical research or educational practice. Very little empirical research has investigated the construction of explicit

instruction with the aim to train non-native scholars to write for publication. What has been available includes the study by Parkinson, Demecheleer, and Mackay (2017), which deals with creating instruction aimed to foster vocational students' acquisition of professional genre, and by Cargill, O'Connor, and Li (2012), which uses collaborative approaches enhancing Chinese scientists' publications assisted by language specialists. The first study focuses on the use of the academic socialization approach to support vocational students' exposure to professional genre, which is useful in terms of corpus and its classroom application. However, the research merit seemed to focus on vocational education rather than scientists or researchers in science, those whose work activities are particularly oriented to language and register in science. In the second work, the language specialists who helped with the strategy and action to encourage collaborative publication seemed to simply solve short-term problems to expand the growth of scientific discourse. However, the professional training for academic writers should include skills for sharing research in the form of RA publishing. These training modules should take into account scholars' goals and implement skills including observation, reflection, application, and practice. The training should also be inclusive of all ages, levels and backgrounds of learners. The research study that emphasized the explicit instruction designed to encourage non-native inexperienced scholars to acquire academic conventions of all required levels and gain such skills of writing should be useful for their workplace and research communities.

This study, therefore, aimed to explore possibilities to construct an instructional model used in teaching Thai research assistants in the sciences to write for publication. However, it remains unknown how to develop the instruction with this purpose and whether the one constructed would offer positive effects for the participants' learning to write. As a result, this study resorted to the research-and-development (R&D) design, in which Phase One investigated the participants' problems and needs in scholarly writing so the data would determine the instruction elements more effectively; Phase Two explored the relevant studies and perspectives for the instructional model and testing of its effective use; Phase Three retested the effectiveness of the revised model for actual practices. In this paper, two major findings that answer the two questions, as shown in Table 1, are consequently reported—one representing the initial phase, and the other taken from the final research phase indicating the effective model for actual use in the future.

Table 1. Three-phase research questions.

Research Phases	Research Objectives	Research Questions
Phase 1: Problems & needs explored for model construction	To construct an instructional model based on the data revealing the participants' problems and needs in writing for scholarly publications.	1. What are the participants' major problems and needs in relation to English writing for scholarly publications?
Phases 2 & 3: Testing & retesting the model	To examine the effectiveness of the model constructed and revised for actual use in writing for publications.	2. What were the effects of explicit instruction on participants' competence and abilities in scholarly publications?

The Study

A concern is that with insufficient knowledge and skills in scholarly writing, the non-native novice scholars need certain feedback that provides possible solutions. As, such, I needed to put together some related instructional model that could effectively serve these scholars' problems and needs in scholarly writing. However, developing the instruction with such a purpose, as we always realize, is highly challenging, and its consensus for pedagogical merit is rarely met by related parties (Bardovi-Harlig, 1995). Given the complexity of instruction or intervention, this pioneering research to prepare marginalized groups for publication needed two-fold examination: to obtain primary data reflecting the problems actually encountered by Thai apprentice scholars through pre-study interviews, and to explore possibilities that make use of relevant studies and theoretical perspectives. The primary data served as a preliminary to the needs survey process and would inform the development of instruction; the latter information drawn to construct the instructional model and to serve such needs more pertinently. Both of these methods were considered through research as problem-based, research-informed practices where the participants' perspectives and needs that apply to the focus of this study should help correct the authentic problems for these non-native apprentice scholars. The data both from the pre-study interviews and the literature took place in different settings, but shared some commonality. They both needed explicit instruction to serve as guidelines for scholarly writing.

This review consequently discusses the data revealed in the process of pre-course interviews, how relevant studies and perspectives in the fields of applied linguistics informed explicit instruction as a means of intervention, and, perhaps, most importantly, the elements of the instructional model. The outcome of what has been reviewed would be used by participants for research sharing in the discourse community and be expected to provide knowledge and skills for future scholars.

Pre-Study Interviews: Preliminary Data to Under the Research Context

To understand the context of this study, I investigated whether the same issues took place in science institutes where Thai novice professionals work so the data could be used as the instruction determinant. With this purpose, some pre-study interviews were conducted to collect the data from three sources. First, according to the Human Resources Unit of a science institute, any activities or research in science are generated by researchers and research assistants, with the former playing a supervisory role in research projects and the latter assisting with research activities. As noted by the HRs, there was quite a high turnover rate among the support groups despite their well-established institute and provided fringe benefits. Second, discussion with five research assistants revealed that there were some concerns about career path opportunities and assessment problems due to their insufficient knowledge and skills in sharing research knowledge in their community. The fact that these professionals graduated from non-English science programs could probably result in lower exposure to science communication through English spoken and written modes. This could explain some limitations I found in their RA samples—(a) inaccurate use of complex sentences and clauses, modifications, tenses, and cohesive markers within and across paragraphs, (b) some RA sections, especially Introduction and Discussion, deviated from rhetorical conventions of published RAs, and (c) some less intelligible sentences appearing in the samples probably caused by Thai interfered translation. The information derived from their writing samples indicated the same problems documented in

the literature, but these problems were observed as primary data which indicated that the difficulties were too complex for correction. The mistakes did not simply fall into basic categories of language like tenses or subject-verb agreements found in general books emphasizing study skills for non-native learners, but these mistakes indicated knowledge and skills to be offered for long-term solutions to their problems. This set was confirmed by the third source of the data, the interview with two researchers supervising labs. As they expressed, those research assistants under their supervision were not engaged much in publication process. Trying to avoid correcting mistakes repeatedly occurring during this process, both decided to write RAs with other team members taking other minor roles. At this science institute, writing to publish the research was achieved by the researchers or the leaders of research labs. The fact that most published RAs appeared with several authors could reflect the nature of research in sciences that need individual expertise. This could also be another alternative for research publishing team members' satisfactory job appraisal. The pre-study interviews data made me aware that in addition to knowledge in methodological design, language in science does play a certain role in positioning the non-native scholars in their working context.

Literature Review: Relevant Resources for the Explicit Instruction

Noted by Tardy (2005), scholarly writing requires advanced academic literacies associated with "rhetorical insight into disciplinary community" (p. 326), and linguistic features, which are very sophisticated and thus "beyond the ability for many individual authors" (Luo, 2015, p. 90) especially these non-native inexperienced writers. As such, what bridges the gap between these novice individuals' current language ability, which was insufficient for publication, and the required knowledge and skills in scholarly writing, the higher level of knowledge and ability in rhetorical structure with its specific linguistic elements, is a mediation between the available resources for knowledge of scholarly writing and what is available in the actual practice of novice individuals (Adnan, 2014; Flowerdew, 2008; Li, 2007, 2012; Lillis & Curry, 2006; Prior, 1998; Sheldon, 2011). The former could be achieved through the use of research findings in relation to genre or corpus analysis; the latter, published RAs in the fields for which those Thai research assistants were serving. What medicates these two resources could be explicit instruction, provoked to facilitate the process of writing for publication in science (see Cargill & O'Connor, 2006; Li, 2006a, 2006b, 2007). Considering these recommendations and data derived from the pre-study interviews, I situated my review in relation to the approaches to academic writing instruction: the academic linguistic skills essentially useful for forming language foundations, the academic socialization approach encompassing genre and corpus analysis and thus highly reflecting the missing knowledge for research publication, and the academic literacy with respect to awareness in disciplinary genre, identity, and some elements of metadiscourse.

Academic Linguistic Skills

The preliminary data obtained from the pre-study interviews and the existing empirical research findings informed the initial idea of the instruction to be designed. Those apprentices' problems with a solid foundation of academic content skills certainly reflect the need for the academic linguistic skills, also known as study or language skills. The linguistic skills are placed among the higher orders of skills necessary for writing for publication, in which early practical intervention has been increasingly used to help learners regardless of levels of proficiency (De

Graaff & Housen, 2009; Eskey, 1983; Rosenthal, 1996). Despite its simplicity, practices in and explicit instruction for academic language skills are needed to foster learners' language improvement (Eskey, 1983), especially those on college levels (see Ivanic, 1998; Lea & Street, 1998). Through some form of such practice and instruction, learners' study skills have significantly improved over time (Rosenthal, 1996), which then transferred to higher levels of interlanguage development (De Graaff & Housen, 2009). However, the effective use of this approach to academic language instruction should not be limited to college learners. Its merit has also been extended to those non-native scholars (Flowerdew, 2008; Li, 2007, 2012), who have been found to struggle with basic but primary elements of language, such as complex syntax and modification. However, academic language instruction, despite its frequent implementation in various universities of the UK and the US, has been criticized as a practice that divides writing from thinking (Mitchell & Evison, 2006), isolating surface language elements from disciplinary knowledge (Lea & Street, 1998).

Given this conflicting view, I then explored more empirical works associated with publication in science. The instructional model was further informed by more research results (e.g., Biber, 2006; Biber, Johansson, Leech, Conrad, & Finegan, 1999; Carter & McCarthy, 2006; Hacker, 2003; Hinkel, 2004; Santos, 1988; Weissberg, 2005)—academic writing and its more advanced forms are still necessary for any groups labeled as non-native, and need certain kind of language—nominalized constructions, post-modified and complement noun phrases (Biber, 2006; Carter & McCarthy, 2006), verb forms including tenses and lexical choice (Santos, 1988), modal verbs (Flowerdew, 2001), passive voice (Hacker, 2003; Hinkel, 2004), and some textual elements, such as metalanguage (Ventola & Mauranen, 1991). Five suggestions by Weissberg (2005) were also important for writing with this purpose in science—using nouns rather than verbs, using subordinating clauses rather than coordinating ones, using non-finite clauses rather than finite ones, using post-modified, prepositional phrases rather than clauses, and using pre-modified nouns rather than post-modified ones. As a result, in the first stage of the instructional model, the written language register finally selected included nominalization, subordination, non-finite clauses, prepositional phrases, and pre-modification of nouns. These primary groups of academic linguistics were stepping stones for the participants to move on to more advanced levels, including composing skills and RA writing.

Academic Socialization with RA Rhetorical Conventions

The participants' problems with insufficient knowledge and experience in composing skills, unclear thought patterns, confusing thoughts organized within or between paragraphs informed the integration of paragraph writing, thought patterns with language functions, and essay writing. My research experience and the primary data elicited from the pre-study interviews convinced me that the craft of paragraph writing is an important ground for skills essential for more advanced levels of writing. With the principles of paragraph development with coherence and unity, and any important logical thoughts of text patterns (Clouse, 2006), such as definition and description, cause-effect and classification, comparison and contrast, the participants should learn to write and argue in various ways. When the participants have gained knowledge and skills with this primary level, their writing skills with arguments for more advanced writing skills in essays and RA writing would be another necessary element. These considerations are well supported by empirical research that manifests importance of skills in paragraph writing (see Reid, 1994; Rooks, 1999). In fact, there have been a few instructional courses aiming to offer

instruction or intervention for workplace professionals (Cargill, O'Connor, & Li, 2012; Parkinson, Demecheleer, & Mackay, 2017. However, these studies did not include the skills in these areas of invention. Perhaps, the participants of these studies could have acquired composing skills due to some factors such as their language background or their learning/working contexts. However, the participants of the present study were non-native apprentices who did not have experience with these important areas. Informed by the participants' actual problems, the instruction should incorporate the skills and ability in composing paragraphs and essays with logical thought patterns. This justification should prepare the participants to have fundamental skills of composing and RA writing after all.

Owing to the rhetorical problems appearing in the research assistants' writing samples, the academic socialization approach to instruction for academic writing should be taken into account. However, this approach situates learning as frames that aim to "identify and induct" (Lillis & Scot, 2007, p. 13), meaning that it focuses on fostering learners' acquisition of academic language. If viewed through the lens of written exploration, this approach may not encourage this goal as much as writers' texts seem to be controlled based on the pre-conceived organizations called rhetorical moves in genre analysis. However, writing for research publication puts emphasis on texts in specific contexts and discourse communities as readers, rather than writers (Grabe & Kaplan, 1996). As such, the academic socialization approach with genre analysis studies in relation to move analysis, and some linguistic features drawn from corpus linguistics were considered very helpful for the writing-for-publication instruction. These research areas share some commonality. Genre is defined as a social practice shared by the members of the discourse community (Swales, 1990). To describe genre, linguistic-based studies were conducted through the analysis of move, a text with functions representing communicative purposes of genre (Biber, Connor, & Upton, 2007; Connor, Upton, & Kanoksilapatham, 2007). Moves with high frequencies are marked as required or conventional moves. Each move may contain steps (Swales, 1990), considered as strategies in Bhatia's (1993) view. These steps serve to support their move for identification of the move's purpose (Swales, 1990). In written texts, corpus analysis, dealing with a collection of naturally occurring texts (Sinclair, 1991) treated as linguistic data, could be of use in that certain linguistic features in each RA section could be applied to the academic language essential for particular purposes. Therefore, the studies in the fields of genre/move analysis and corpus linguistics complementarily serve as the macro and micro levels of rhetorical structure and academic language of RAs, respectively.

For the choice of the research results in these areas, the RAs that have been cited or implemented in various studies were drawn as models for best practice of RA rhetorical structures and linguistic features. The participants would consult them during the intervention process. The Introduction section was influenced by Swales's (1990) model with 3 Moves— establishing a territory through topic generalizations, establishing a niche, and presenting the present work—and some comments showing some variation by Kanoksilapatham (2005). The frameworks for RA writing taken from these studies could answer why the large number of non-native writers participating in the studies mentioned earlier failed to publish their research. In most cases, they rarely presented their research gap or questioned the current practice, some of which were caused by their rhetorical moves different from the community expectation or conflicting view between the normative practice and their own sociocultural background. The rhetorical conventions and certain linguistics used in this section should be of use to the non-native writers in this study. The same should also be applied to other sections of RAs.

As Kanoksilapatham's (2005) framework presented a complete model drawn from Biochemistry RAs, her model was used in all RA sections. Here, the Methods section was assisted by Kanoksilapatham (2005) and Peacock (2011). The former, with the focus on data taken from well rated Biochemistry articles, reveals the moves with describing materials, experimental procedures, equipment, and statistical procedures. The latter provides the data taken from eight disciplines with science showed different moves between science and its counterparts, and this model should help non-native scholars to be aware of disciplinary variation. Also, the Methods section analyzed by Lim's (2006) model could be applicable, although his data were taken from Business Management. As such, I incorporated this model into the study as his three moves—data collection procedures, variables measurement, and data analysis—allow some room for justification of research activities, which, remarkably, reflects how successful researchers solve their research problems throughout the inquiry process.

In the Results and Discussion sections, I still made use of the model by Kanoksilapatham (2005). Four moves were used in the Results section—restating methodological issues, justifying methodological issues, announcing results, and commenting results. Another four moves were used in Discussion—contextualizing the study, consolidating the results, stating limitations, and suggesting further research. In RA Results, the first two moves and the last should help non-native writers to be aware that the discussion of related points in the Results section should benefit them by helping them to produce higher quality manuscripts, compared to the presentation of results alone. In RA Discussion, non-native writers could observe that writers publishing their work in well-rated journals tended to wrap up some important points in the last RA section and suggest some useful ideas for future researchers. In addition to the model by Kanoksilapatham, the model by Yang and Allison (2003) presented valuable insights, although the data were drawn from applied linguistics as the model connects the Results, Discussion, and Conclusion sections, all of which are connecting the points discussed in the moves drawn from these sections.

In the Abstract section, some models were practical. For instance, *American National Standards for Writing Abstracts* (1979) provided four standard moves—scope and purpose, methodology, results, and significant conclusions. The model by Swales and Feak (2012) also provided useful guidelines for writers through its six moves—outlining the topic, justifying the research, reviewing the methodology, commenting on demographics or procedures, summarizing the main findings, and highlighting the outcomes/results, further observations for implications, limitations or future developments. However, the Abstract section should be taught as the last section so the participants could notice rhetorical moves and linguistic features of the section and gradually acquire the conventions underlying the section better.

As can be seen, the knowledge derived from the studies with genre or move analysis should be useful for Thai novice writers to write all sections of RAs correctly and effectively. The participants should be addressed to acquire the RA macro sections—A-I-M-R-D—and linguistic features constituting the purposes of the moves in these sections. Here, these influential RA models were used as main resources for the participants to consider when writing their RA manuscripts. As influential frameworks used in various studies with genre or corpus analysis, these models should serve as the generic structure to be applied in science and other disciplines. In addition, the RA framework and language guidelines in Weissberg and Buker' (1990) work could be applied for the participants in various disciplines of science.

However, application of the knowledge derived from these studies and frameworks in actual instruction should not be prescriptive. Genre, originally viewed as a text type, has become

"a multifaceted construct characterized by a range of features that include social actions, communities of practice, power relations, texts, and the interactions among texts" (Flowerdew, 2011, p. 120). As such, genre should not be limited to a traditional view focusing on types of texts any more. How Flowerdew defined this concept does reflect the nature of genre that can be applied in explicit instruction, in which two models proposed by Beaufort (2004) and Tardy (2009) were put into use. The former was viewed with five dimensions and the latter four, both of which contain similar domains. The five domains of genre knowledge that Beaufort proposes include (1) writing processes knowledge of genre, (2) subject matter knowledge, (3) rhetorical knowledge, (4) genre knowledge, and (5) discourse community knowledge. The model by Tardy contains all but discourse knowledge. While Beaufort views the discipline as an important entity for writing, Tardy might see this domain and the subject-matter knowledge as dual representation, where one could be referred to as the other. Consequently, both could be more or less the same. However, the discourse community dimension, despite its broad definition, is important in the sense that it highlights a manner of knowledge and style and language for presentation. As such, the designed instruction was oriented to the five-dimension genre model by Beaufort (2004) with some rearrangement justified with the sequences of these domains applied in actual instruction. The first two dimensions of genre include the 'discourse community knowledge' that informs certain methods of knowledge presentation, and the 'subject-matter knowledge,' the research content that does reflect disciplinary genre. These domains, to my interpretation, are most sophisticated, and thus limited to the discourse members and experts in individual fields. The participants would deal with their disciplines by translating the research content into writing manuscripts appropriate for their working contexts. With the shared contexts and regularities, they should write for and in their academic discourse, which is reflected by the third and the fourth domains of genre knowledge—'formal knowledge,' and 'rhetorical knowledge.' 'Formal Knowledge' refers to the genre structure, including conventions in discourse, move structures, and lexicogrammar, and 'rhetorical knowledge' to the intended meaning or the purposes that encompass socio-rhetorical of the genre. Clearly, the knowledge of genre structure serves as the holistic backbone of target discourse whose community members and audience can identify text types clearly. The nature of both 'formal knowledge' and 'rhetorical knowledge' make genre meaningful and specific for each target context. However, genre should not be simply taught as a fixed entity (Martin, 2009); rather, the structure or individual moves of each genre should be informed by actual meaning and purposes. Then, genre should be viewed as process knowledge, the fifth dimension of the models, when its implementation is put into use as composing processes, in which writers put together all domains of genre in order to produce RA manuscripts. Through these domains of genre knowledge, the research studies relevant to scholarly writing would be visible and expounded as a baseline for explicit instruction for Thai research assistants to write for publication.

Academic Literacies

In real-world practice of science, non-native apprentice scholars, including Thai research assistants, need to develop from apprentices to fully grown scholars in their career path, and scholarly writing is one of the major tools facilitating their career development. However, the instruction in academic linguistic skills, and the academic socialization approaches used in the first two fundamental stages may not be able to provide scholarly writing skills most effectively. Through language skills and genre recognition, which view learning as "a generic set of transferable skills" (Kelly-Laubscher, Muna & Van der Merwe, 2017, p. 20), these novice

scholars would rarely be encouraged to achieve their success, have opportunities as research assistants or capacity to develop themselves for higher positions, and thus provide their scholarly work in their discourse community. In addition to the first two approaches to academic writing, the instruction should consequently make use of social and critical linguistics (see Fairclough, 1992) by integrating language skills, genre convention, meaning making and social relations, all of which are under the umbrella of the academic literacies approach (Lea & Street, 2006). Participants should have mastery of the academic discourse on this level. To define this concept, the instruction at the last stage included awareness of genre variation across disciplines so the participants could estimate what moves were sensible in varying genres. Building awareness would be important due to the number of branches of sciences situated in Thai science institutes where the participants are working. Also, as important contributors of society, it would be necessary for them to be exposed to ideological concepts appearing in the community or genre for which they were about to write.

As a result, the concepts of disciplinary identity and science possibly associated with academic culture and literacy practices were also included in the instruction and were defined as three separate practices. First, various published RAs and multiple influential frameworks for RA writing were addressed so these choices could widen the participants' knowledge and experience in scholarly writing practices. Second, some concepts of metadiscourse were incorporated into the practice so the participants could link the use of these language elements for important arguments in some RA sections, such as Introduction and Discussion. Third, as the instruction also aimed to provide long-term academic writing skills and inquiry skills that could affect meaning or some alteration of final products of RA writing, the instruction included ethnographic skills which allow the participants to explore the moves or rhetorical structures, or any variety of linguistics used in the RAs so they could attain professional communicative competency across disciplines. The ethnographic skill serves as their long-term learning tool, which could be applied even to their epistemology in the long run.

Shown in Table 2 is connectedness between the problems the participants encountered and the studies or perspectives used for solution, all of which could finally be translated into instructional components:

Table 2. Instructional elements informed by actual problems and relevant studies and perspectives.

Actual problems found from the pre-study interviews and in the literature	Relevant studies and perspectives as sources for solutions	Informed instructional elements
Lack of academic linguistic skills	1. academic language skills& linguistic elements in academic writing (Biber, 2006; Biber, Johansson, Leech, Conrad, &Finegan, 1999; Carter & McCarthy, 2006; Hacker, 2003; Hinkel, 2004; Lea & Street, 1998; Santos, 1988; Weissberg, 2005)	Content of academic linguistics drawn from published RAs: nominalization, subordination, on-finite clauses, prepositional phrases, pre-modification of nouns

Actual problems found from the pre-study interviews and in the literature	Relevant studies and perspectives as sources for solutions	Informed instructional elements
Lack of composing skills	2. Composing skills (paragraph building) ▪ Actual problems the participants encountered ▪ Studies viewing paragraph writing as a difficult but important skill (Cornbleet & Carter, 2001; Reid, 1994; Rooks, 1999)	Effectively written paragraphs applied to (and also drawn from) published RAs: development, unity and coherence
Confusing thought patterns	3. Paragraph and text structures essential for writing in all levels (Clouse, 2006)	Thought patterns in paragraph writing also drawn from published RAs: ▪ deduction, induction & mixed approaches ▪ language functions
Confusing thoughts or organizations between paragraphs	4. Composing skills (Essay development) Shared development, connectedness between essays and RAs	Point of connection: essays developed to RAs with a similar backbone
▪ Confusing thoughts in RA sections ▪ Lack of moves developed through RA	5. RA writing ▪ Academic socialization (Lea & Street, 2006) ▪ RA Frameworks (Kanoksilapatham, 2005; Swales & Feak, 2000, 2014; Peacock, 2011; Lim, 2006; Yang & Allison, 2003; *American National Standards for Writing Abstracts*, 1979) ▪ Practice and language in science (Weissberg & Buker, 990) ▪ Published RAs (brought by the participants)	RA writing drawn from published RAs: Abstracts, Introduction, Methods, Results, & Discussion
▪ Lack argument or voice ▪ Writing with fixed language use and style	6. Academic literacies, genre and identity (Kelly-Laubscher, Muna & Van der Merwe, 2017; Lillis & Scot, 2007)	▪ Various RAs and frameworks for the participants' choice ▪ Language and identity, with metadiscourse

Put together, the knowledge obtained from such relevant studies and perspectives helped inform the multiple-staged instruction with proper scaffolding provided by compositional skills in

various levels, thought patterns with language function essential for writing in science, and essay writing skills whose organized thoughts and ideas were the same as those in RA sections.

All of the perspectives and practices used in this explicit instruction were hereafter termed the "Scholarly Writing Builder," (SWB), "the instructional model," or "the SWB model" interchangeably referred to in this study.

Instructional Model

The attempt to make use of relevant literature in relation to these approaches to academic writing to inform the SWB model was fulfilled. As the final product, the model used in this study is composed of a number of important considerations—its teaching elements, and related issues in relation to the model implementation.

Model Elements

Informed by the integrated approaches to academic writing and relevant studies in genre or corpus analysis, the SWB model consists of six elements starting from linguistic academic and composition skills with paragraphs as two fundamental levels of higher orders of skills in essays and RA writing. As shown in Fig. 1, the first stage of the model aims at writing foundations for publication by offering academic linguistic skills, including nominalization, subordination, on-finite clauses, prepositional phrases, and pre-modification of nouns, essential for writing in more advanced levels in stages 2-4—paragraphs with text structures and essays. Stage 5 fosters skills in RA writing through the academic socialization approach accomplished through genre analysis and RA frameworks serving as the references for scholarly writing consultation. The model concluded with the last stage dealing with some elements of awareness in genre variation and ideology embedded within disciplines. As can be seen, the elements of instruction were graded systematically from the most basic component to more complex ones, and these elements could be viewed as the instructional stages with time allocated appropriately on the basis of difficulty levels, in which the whole instruction needed 48 hours. It is noted that all content of the instructional model is composed of the writing content generally assigned for the four different courses: sentence, paragraph, essay, and RA levels. However, in this research, the instructional model contains the four-course writing skills that are combined into one 48-hour course. The number of hours and the coverage of practices aimed to accommodate the participants whose time should be allocated to meet their job requirement. As such, the model with all elements constructed and justified could be effective for the participants' work factors.
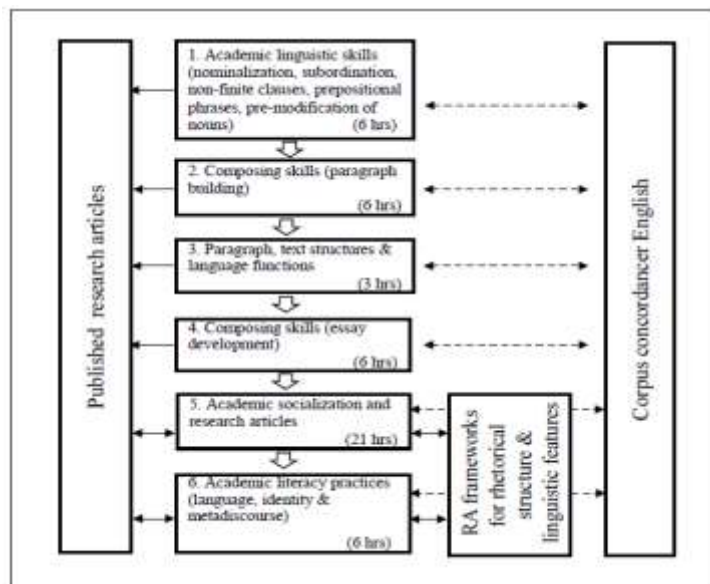
Fig. 1. Elements and stages of the SWB model.

Teaching Approach and Instructional Justifications

Informed by the literature in the field of corpus or genre analysis, writing for publication, and its training for specific groups of professionals, the explicit instruction through the lens of English for specific purpose genre pedagogy should be a means to this end. Genre pedagogy through ESP approach has been found to make the participants familiar with their disciplinary genre (Cheng, 2007, 2008; Costinao & Hyon, 2011; Hinkel, 2006; Hyland, 2004, 2007; Lee & Swales, 2006; Swales, 1990). A number of studies assert that the use of explicit instruction can foster learners' genre knowledge (Henry & Roseberry, 1998; Hyon, 2001), the social context of such a genre (Williams & Colomb, 1993), writing quality with respect to organization achieved through cohesion (Yasuda, 2011), awareness of audience (Yasuda, 2011), awareness of genre or rhetorical patterns and their functions (Cheng, 2011), and disciplinary culture that may govern genre structure (Chang & Kuo, 2011; Lee & Swales, 2006). Through the explicit instruction with the ESP approach, the participants should position themselves as the community members by scaffolding with the genre patterns drawn from the target discourse, observing how language functions in their community context, gaining core knowledge of their disciplinary genre and, most importantly, making use of the genre in the production of RAs for their community.

However, the instructional model, for its effective use, needed four adjustments. First, the instruction with ESP genre pedagogy could be less effective or even harmful if teachers delivering the courses are not the insider experts of the target community (Freedman & Richardson, 1997). This is because these experts are always viewed as authority figures for the disciplinary knowledge, and their experience can highlight those newcomers of the field. As a result, I worked collaboratively with two experienced researchers, one of whom helped validate my research instruments, and all of whom participated in the sessions. They shared their expertise both in methodological strategies and specific content, and helped solve any problems with significant mismatch between language used and meaning making in RA sections.

Secondly, we can apply the fifth stage of the SWB model, which is most important for scholarly writing practices. This stage is partly aligned to genre analysis in the ESP approach. The instruction should encourage the participants to view writing practices as processes for social action, as part of systemic functional linguistics, which views language and meaning making as dynamic, dual entities in contextualized practices (Martin, 2009). As such, the instruction also emphasized interconnectedness of purpose for each RA section or the whole paper, rhetorical moves with linguistic features, and disciplinary audience, in which meaning and form were realized inseparably. With this justified method, the participants were expected to realize about RA genre with its related elements, and awareness of disciplinary audience, both of which would play a crucial role in the participants' writing practices.

Third, with respect to the participants' learning engagement, the merit of genre knowledge was maximized by familiarizing the participants with multiple dimensions of the genre—regularities drawn from its theory and the actual practice for which the participants work. For more contextualized learning, meaning and the genre patterns were discussed throughout the instruction, aiming to encourage the participants to engage in genre exploration and to draw its patterns successfully, which could be achieved through the analysis of RAs of each participant's field.

Fourth, although the instruction aimed to coach the participants to acquire skills for scholarly writing, the fact that the participants were mature learners with meaningful life and work experiences, the instruction designed should be achieved through class discussion, rather than language practices. Bakhtin's (1986) dialogism, viewing language use and human activity as interwoven entities, should explain this justification. To Bakhtin, one's oral or written utterances by nature are dialogical, which signifies specific content, style and structure of each context. This view should encourage the participants to understand all the learning concepts or skills through interaction. The participants, while on task, were consequently encouraged to explore awareness in genre and discourse identity within individual disciplines. Class discussion used as a major teaching method in all stages was in conjunction with other methods, such as working in groups, pairs, and individually, all of which focused on writing skill development and knowledge sharing. All these methods could elicit the participants' effort in analyzing and thinking, writing and revising, which then shaped their academic abilities.

All the justifications reflected relationships between the element and stages of the instruction model, and the use of resources essential for RA writing, published RAs, RA frameworks for writing conventions, and corpus concordancer English, as shown in Fig. 1. The teaching of all stages was conducted in conjunction with the observation of these authentic sources and language, which could inform the participants how the language and skills of the four stages function in actual publication. At the summation of each learning stage 1-4 (academic linguistic skills to essay writing), the participants were encouraged to observe how such word choice, sentence construction, and elements of paragraphs or essays serve scientific prose. In stages 5-6, RA writing, the instruction could be more dynamic as it could be done deductively or inductively, depending on the complexity of each RA section and the participants' English proficiency. It could start with writing practices of each RA section and then move on to the authentic source observation. Also, the instruction could be applied the other way around. By the end of the course, the participants were expected to come to realization of related elements and skills needed for scholarly writing, to have awareness with disciplinary genres, and to write for their actual practices effectively.

Use of Published Research Articles and Influential RA Frameworks

The instructional model that frames learners' writing according to rhetorical conventions or regularities of genre could be considered the normative practice. However, specific subject areas and disciplines may need different genres for knowledge construction (Lea & Street, 2006). Therefore, instruction based on the academic literacy practices should move beyond a prescriptive act of disciplinary conventions, by encouraging the participants to take a critical lens in relation to their actual practice, where genre knowledge should not control their meaning making but the participants themselves have some awareness of their own voice and some genre variation in real world practices. It then appears that using published RAs comes into play as one, among many, teaching methods that let the participants observe rhetorical conventions and some specific use of language in science RAs.

The published RAs in this study were used in three major functions. First, some published RAs were taken from well-rated journals relevant to the participants' disciplines—top-five journals in Biochemistry as used in Kanoksilapatham's (2005), RAs written by Arthur Kornberg, a Noble Prize-Winning biochemist, and other researchers in Journal of Biological Chemistry, as used in Thompson (1993). As the model shown in Fig.1, these high quality published RAs were used to support learning through genre observation in all stages of the instruction. In the sessions with linguistics used and writing in paragraph and essay levels, the instruction given and RAs observation were in concert as the RAs were the main source for any examples related to the lessons or writing tasks. In addition, another set of published RAs brought by the participants was very useful as the RAs were taken from the participants' disciplinary journals (e.g., *Science, Nature, British Medical Journal, Journal of the American Chemical Society, Green Chemistry, AngewandteChemie International Education, Advanced Energy Materials, Catalysis Today*), treated as authentic texts representing their best practice to foster the participants' socialization of academic convention. The same method can be used in the session with metadiscourse, genre and identity. This inductive learning was reported to foster the participants' insight into the way in which genre of their discipline and of others is analyzed for rhetorical patterns. Given the participants' high logic generally appearing in science activities, this method was very effective as it could trigger the participants'logical thoughts for the purposes of those rhetorical conventions. As we can see, the main role the published RAs took in the instructional model used in this research should provide positive gains to the participants' learning.

The second function these published RAs served was in use of the generic frameworks of RA writing. The participants, while writing and revising their RAs, could consult ways in which rhetorical conventions or moves were expected. These major frameworks include Kanoksilapatham (2005), Swales and Feak (1990, 2012), Weissberg and Buker (1990), and others, and they represent the generic structure in science and related disciplines. However, the participants were encouraged to observe variation or possible conventions in their own field so the frameworks could be justified in their actual practice.

While these frameworks serve as practical guidelines, they also serve the third function in the instruction used as a springboard or baseline for more exploration of genre or rhetorical conventions possibly found in other journals within or across disciplines. Through the use of the published RAs as authentic texts, the instruction should instantiate the genre of particular discourse communities (Swales, 1990). This ethnographic skill was integrated to prepare the participants for their real world practices, in which they might encounter any other problems in

relation to genre and rhetorical convention beyond what they would find from the instruction. Their expanded horizon could be useful for their own development and their institute.

Working Collaboratively with Experts

Who should take the main role in the instruction? The answer to this question has been debated, especially within the instruction specific for disciplinary discourse. Three alternatives have been argued: co-teaching between writing specialists and disciplinary experts (Smith, 2003), the two with equal proportion of teaching (Northcott & Brown, 2006), language professionals as a main role and content experts as minor ones (Melles, Millar, Morton & Fegan, 2005). The fact that the participants were the apprentices in science led to the decision for the instruction of this research. In general, writing is viewed as most problematic (see Dueraman, 2012; Glass, 2008) as it requires a number of sub-skills. Challenging enough, the instruction here aimed to encompass all levels of writing skills. Because of this, those who are not language experts might not be able to deliver an advanced writing course effectively. The same problem applied to language teachers who may decide not to teach courses with specific content due to their insufficient knowledge. This problem was finally justified by the reason that the instruction aimed to help the participants to write for publication with greater emphasis on six elements of academic writing practices, whereas content or methodology in sciences was not focused here. Looking into my experience as a teacher and researcher of writing instruction, both in college and workplace-related courses, I finally served as a course teacher working collaboratively with two experts in science content, both of whom were the researchers supervising scientific labs for over ten years. These researchers participated in the instruction taking multiple roles, collaborators, learners, and co-interpreters for the data analyzed. They often gave comments related to the research content and the language needed in each writing session. Also, they helped validate the research instruments, course materials, RAs selected as starting materials, and the RA frameworks used as possible guidelines for writing. One of them, in conjunction with two experts in applied linguistics, validated the questionnaires constructed for all research phases. In addition, the pre-research interview data acquired by the two experts in science were considered as part of experts whose view with science activities and the participants' performance both in labs and in this instruction represent the real-world practices of science professionals. Expert resources also included the participants with meaningful experience of instances where language and meaning in science were reciprocally reflected. These multiple sources of experts—in expertise, content and the language—were important entities for the instruction model.

Learning Materials

In addition to the use of published RAs and the frameworks for rhetorical structures discussed earlier, two sets of learning materials were also constructed. The main set was a handbook with detailed description of how to write complete A-I-M-R-D RAs. This handbook was achieved through my extensive review with textbooks, such as *Writing up research: Experimental research report writing for students of English* (Weissberg & Buker, 1990), *Scientists must write* (Barrass, 1978), *The craft of scientific writing* (Alley, 1996), *Technical writing and professional communication for non-native speakers of English* (5th ed.) (Huckin & Olsen, 1991), and related research articles, as discussed earlier. The second set of learning materials contains supplementary exercises related to academic language taken from *Cambridge English for Scientists* (Armer, 2011), and *Academic Vocabulary in Use: Vocabulary reference and practice*

(McCarthy & O'Dell, 2008). The validation of these materials was achieved through formal discussion with two researchers in science, the same experts working collaboratively during the instruction.

Learning Tasks

Learning tasks here were the individual sections the participants wrote during instruction. The sequence of the tasks was arranged based on the complexity of thoughts and writing skills reflected in the participants' work or lab activities starting with Methods and Results, their most familiar tasks in actual labs, moving on to Introduction and Discussion, which required higher skills of planning for thoughts, research content, and language, and concluding with the Abstract, a summation of all thoughts and skills derived from the previous sections. These learning tasks were considered as the RAs used as another source, in addition to the participants' pre-test and post-test papers, to indicate their abilities in scholarly writing and thus the effective use of the instructional model constructed. (See the details of learning-task evaluation in 3.5.2 Assessment of the Participants' Written Research Articles).

Validation of the Instructional Model

The model was validated through a two-fold examination—agreement by specialists, and the model tested with a pilot study. For the first examination, the model was validated through three experts in the field of applied linguistics, L2 writing, and scientific writing. The first two specialists are Thai EFL teachers with applied linguistics and corpus studies backgrounds validating the theoretical, sense making and actual use for instruction. The third specialist is a senior researcher working in a science institute whose role was to consider the effective use of the model. The second examination of the model validation was the pilot study with fifteen participants working as research assistants in science, having the same backgrounds as the participants in Phases Two and Three. With a high grand mean (Grand Mean = 3.81 on 4 scales) shown in an attitude survey, the model was viewed positively with clear objectives.

Review Summary

The suggestions with respect to some explicit instruction for scholarly writing were believed to assist non-native apprentice scholars to write for publication more effectively (Cameron, 2007; Cargill & O'Connor, 2006; Flowerdew,1999a, 1999b; Gosden, 1995; Li, 2006a, 2006b, 2007; Swales' 1990; Tychinin & Kamnev, 2005; Wang & Bakken, 2004). The fact that these professionals were mature in work experience but needed support for many levels of writing skills made the action for these suggestions challenging. More importantly, it is unknown how to design the instruction to serve professionals in the workplaces with very rigorous, specific disciplines, whether the instruction would offer positive results in terms of the participants' ability to write for this purpose and to position themselves effectively in their institutes. The studies that explored possibilities that utilize the available related literature in relation to the instructional model used in actual practices can be shared by scholars within their communities. In Thai research contexts, there has been little research on creating the instructional model drawn from two connected sources—the science novice professionals' academic background, problems and needs that should be served appropriately, and the relevant studies and perspectives in related fields—with emphasis on complex levels of writing that serve the purpose of their job

positions. The intention of this research is consequently to explore whether the instructional model designed could help science professionals to gain knowledge and skills in scholarly writing. The SWB model is expected to serve these important professionals as another tool for sharing research.

Research Methodology

This study aims to develop an instructional model used in training Thai research assistants in science to write for publication, resting on an R&D design. This section describes a framework shedding light on facets of the study—research ontology, epistemology and axiology—and the detailed description of research methodology covering important elements of research.

Research Framework

The conceptual framework underlying this research contains three important elements: (a) ontology, what are knowledge claims, (b) epistemology, how we attain such knowledge, and (c) axiology, what research merit is derived (Creswell, 2003), as illustrated here:
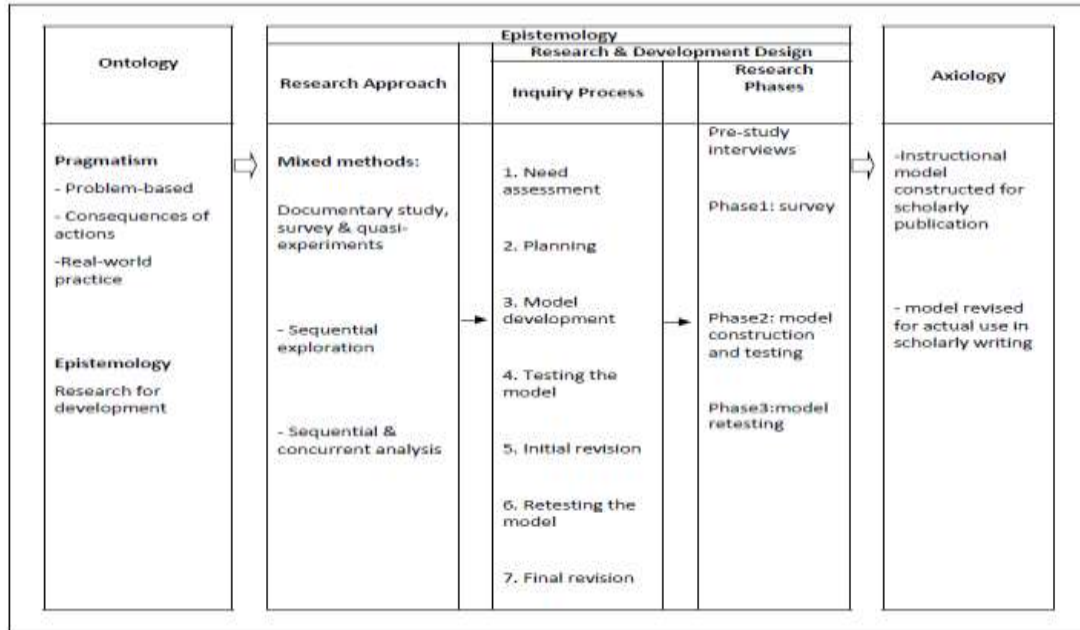
Fig. 2. Research Framework.

The research ontology used in this study corresponds to schools of pragmatism emphasizing problem-based inquiries where real-life consequences are examined through multiple truth frameworks as the very way to understand reality (Cherryholmes, 1992; Creswell, 2003). With pragmatism as the approach to problem solving, mixed-methods analysis is ideal. "One professing the superiority of 'deep, rich observational data' and the other the virtues of 'hard, generalizable'…data" (Sieber, 1973, p. 1335). The practice recommended in Sieber's classic work supports the use of multiple approaches to understand the problems encountered by the participants, the priority for this study, in which both 'hard data' quantitatively explained and 'deep and rich data' revealing the participants' intense difficulties accessed qualitatively were

met for analysis. In this R & D framework, the inquiry processes included seven stages: surveying the participants' problems in scholarly writing, planning for related elements of a teaching model serving the participants' problems and needs, developing the model based on such problems and needs, testing the model in an actual workshop, revising the model, retesting the adjusted model in another workshop, and finalizing the model for applications. It is believed that the approach used in this research is the best epistemology to derive knowledge claims for this study.

Research Participants

This study consists of three phases—a preliminary survey, creating and testing a model used in scholarly writing, and retesting the model previously revised to assess its effectiveness in practice. In Phase One, the survey aiming to collect the data uncovering the participants' problems and needs in scholarly writing was conducted in 2009/2010. As the research aimed to reveal actual problems and needs among Thai professionals in science, a sampling with a lower bias with the inclusion of participants was targeted. However, using the conventional, systematic sampling for research in social practices could be far from practical as the total number of professionals in science from the whole country was not accessed. With coordination from Human Resources (HRs) Unit of each institute, Phase One relied on a random sampling in a justified manner with five steps: (1) selecting public science institutes, (2) job specifications with researchers and research assistants indicated by HRs, (3) inviting every one with these two job specifications for research participation through HRs coordination, (4) allocating two months for wait time period, and (5) recruiting any accepting the invitation.

The same process was applied to three science institutes situated in Bangkok and suburban areas, the centers for public workplaces. Finally, the inclusion of participants was finished (N=125), including researchers in science (N=21) obtaining doctorate in scientific areas, and research assistants in science (N=74) with Master's degrees in science-related areas, and research assistants in social science (N=30) earning Master's degree in social science and linguistics. The participant inclusion process, which was random with some justification, could reinsure the data representing actual state with writing for publication.

With the data from Phase One, the model was formed and tested in Phase Two through experimentation in 2011 with the research assistants (N=25) randomly selected from those participating in Phase One, using a first-come-first-serve basis. The research assistants in science were selected as the Phase-One data indicated a stronger need for scholarly-writing training, compared to the other two groups.The Phase-Three research was conducted in 2012 aiming to retest the effective use of the model revised in the previous phase, with the same random sampling used in Phase Two with some justifications, having more participants (N=30). The participants in all phases shared the same background, working in scientific areas, such as material science, biochemistry, engineering, computer science, and other science-related areas. Although the whole process was time consuming due to the wait time period for their response, the results obtained were believed to represent a clear picture in relation to the science professionals' scholarly writing. The data obtained from Phase One would inform ways in which the instruction could be constructed with effective use; those in the other phases would indicate the extent to which the model could be applied in actual practice.

It is worth noting that the remaining number of research assistants in science (19) was invited to participate in the pilot study, but only fifteen assistants agreed to join.

Data Collection Methods

In Phase One, the data were collected through the survey, with writing samples offered by some participants, all of which were considered as problems and needs in each level of writing. Phases Two and Three aimed to test and retest the instructional model created based on the data derived from Phase One. Consequently, the data obtained from the experiment were used to verify the model effectiveness through multiple sources, including the participants' pre/post test papers, written research papers, interviews and observation, and attitude surveys. These various sources served as triangulations of the data, offering more reliable interpretations (Creswell, 2003).

Research Instruments and Their Validity

Two Sets of Self-Reported Questionnaires

Two questionnaires were constructed, one used as the survey drawing the participants' problems and needs in scholarly writing in Phase One, the other constructed to elicit the participants' attitudes toward their writing practices with the instructional model in Phases Two and Three. The tools were designed with some justification. Thai research respondents, for some reason, tended to choose the "undecided" band, the value in the middle position of the five-rating scale. Accordingly, I used a four-point scale, instead of five, with the middle band, "undecided," dropped. The justified format was made for the participants' certain response, strongly agree, agree, disagree, strongly disagree, in the survey.

The questionnaire sections of both sets were arranged as themes or major content sections relevant to issues for scholarly writing drawn from the pre-study interviews, the problems documented in the literature, and relevant studies and perspectives.

The first questionnaire used in Phase One aimed to draw the data regarding the participants' problems and needs in writing at various levels. The survey contents include the participants' demographic information, self-evaluated ability, self-evaluated confidence, and awareness of generic features of RAs before participating in the research, and an open-ended section with additional opinions. The second questionnaire investigated the participants' perceived change and the effectiveness of the teaching model. It contained seven sections— demographic information, the participants' self-evaluated ability, confidence, awareness of generic features of RAs, reflections on language, culture, power and identity, attitudes toward the instructional model, attitudes toward the instructional materials, self satisfaction, and an open-ended section for additional opinions. The fact that the thematic contentwas constructed based on the actual problems expressed, and the studies relevant to the research focus, and some modified form with the rating scales, both questionnaires were constructed with predictive and construct validity. The questionnaires were constructed based on theoretical perspectives and the intent to inform practical action (Weigle, 2002).

Both questionnaires were then validated through a two-step examination. First, the Index of Congruence (IOC) was conducted by three experts as suggested in research in education and social science in Thai context (Pinyoanantapong, 1984; Kitpridaborisuth, 1994; Srisathidnarakul, 2007). The IOC values indicated in all sections of the first and the second questionnaire were 0.94-0.97, and 0.85-0.98, respectively, in which IOC ≥0.5 is acceptable for the questionnaires constructed. The IOC values derived here indicated a strong, positive value in terms of content, construct, concurrent and predictive validity. Second, based on Cronbach's Coefficient (1951) and Srisathidnarakul (2007), the reliability of both questionnaires indicated the accepted value of

Cronbach's Alpha Coefficient, where the reliability values (α) appearing in all sections of the first and second questionnaires were 0.94-0.96, and 0.78-0.97, respectively. Mentioned in Cronbach and Srisathidnarakul, the questionnaire with the reliability value higher or equal to 0.70 is accepted as an effective research tool. Clearly, the questionnaires constructed in this three-phase research were of reliability.

Pre-and Post-Test

Proficiency in paragraph writing is found to be an essential foundation for academic writing (Reid, 1994; Rooks, 1999). It is often viewed as a stepping stone for writers, especially non-native ones, to develop their higher ability to these skills needed in more advanced discourse levels. As such, the pre/post writing test of Phases Two and Three of this research was allocated for paragraph writing ability, serving as two purposes: verifying the effectiveness of instructional model drawn from the participants' writing development, and helping with the teaching preparation indicated by the results of pretest scores. The test was designed through the construct and concurrent validity (Bachman & Palmer, 1996; Weigle, 2002; White, 1994)—the former indicated by the participants' writing to be tested based on theoretical perspectives and the latter the test result compared to that by other types of measurement, which, in this research context, is their ability in RA writing. With a topic related to science, the test topic elicited the participants' response to current issues among non-native researchers, problems in publication in international journals, thus appropriate in terms of construct validity—the meaningfulness of the test (Weigle, 2002). The test could indicate the participants' further writing ability, so it also contained predictive validity (Weigle, 2002). For the practicality validity, consensus with the test topic was achieved by three specialists—two English teachers/researchers for theoretical grounding and a researcher in science for sense-making and application of the test content in science contexts.

Research Procedure

Indicated in the Research Framework, this research used the R & D design consisting of seven steps of inquiry: needs assessment, research planning, model development, the model tested, the model revised, the revised model retested, and the final revision of the revised model. Phase One adopted a simple survey for assessment of the participants' problems and needs; Phases Two and Three were conducted with the remaining steps of the R&D process, using one-group-pretest-posttest design. Here the participants were administered with a pretest, followed by the instructional sessions, as explained earlier in the Instructional Model, and concluded with a posttest. Along the process, the participants were asked to do writing tasks as discussed in the Instructional Model and were provided with some data corresponding to the data collection methods, such as writing samples and interviews.

Instruction in Phases Two and Three

The instructional model, extensively discussed in the Instructional Model, was used in Phases Two and Three. The 48-hr instructional model covering all skills essential for the writing-for-publication emphasis was implemented with the participants with sixteen 3-hr sessions,Tuesday/Thursday, or Wednesday/Friday, tailored according to the participants' convenience. These scheduled sessions aimed to allow the participants to participant in the workshop-like instruction actively with the coverage of not only six elements of learning

content—academic linguistic skills, paragraph writing, text structures and language functions, essay development, RA writing, and notion of identity in genre and metadiscourse devices—but also the assignments of such elements with RAs as written products of their learning process. (See detailed descriptions of all the model elements in 2.3.1 Model Elements.)

Assessment of the Participants' Written Research Articles

The participants' RAs written were assessed by a rubric assessment used for academic writing, integrating the view on L2 writing evaluation (Klimova, 2011) and practices drawn from the frameworks used in the instruction (e.g., Kanoksilapatham, 2005; Swales & Feak, 2012; Weissberg & Buker, 1990). Shown in Table 3, the assessment here reflected writing of RA sections justified from the moves and steps mentioned in the RA frameworks (70 points) and language used (30 points) and its use was set after the agreed review by three specialists, the same who helped with the pre, and post test topic.

Table 3. Academic writing assessment.

SENTENCE AND PARAGRAPH STRUCTURE—70 points	Full Points*									
	1	2	3	4	5	6	7	8	9	10
The paper is well organized, clear and develops A-I-M-R-D.	1	2	3	4	5					
The Introduction is well organized and written, clear and develops through 3 moves.	1	2	3	4	5	6	7	8	9	10
The Discussion is well organized and written, clear and develops thoughtful applications.	1	2	3	4	5	6	7	8	9	10
The Methods & Results sections are well described, and tables and graphs are appropriately presented.	1	2	3	4	5					
Abstract is well organized and develops professional moves.	1	2	3	4	5					
Each paragraph is organized, clear and develops one main idea.	1	2	3	4	5	6	7	8	9	
Writes clear, meta linguistic device, appropriate transition phrases, statements, paragraphs.	1	2	3	4	5	6	7	8		
Uses a variety of types of sentences and sentence beginnings.	1	2	3	4	5	6	7	8	9	
Writes clear sentences; academic, lexical bundles, correct and appropriate words are used.	1	2	3	4	5	6				
Uses parallel structure as needed.	1	2	3							
PUNCTUATION, GRAMMAR AND USAGE—30 points	1	2	3	4	5	6	7			
Uses punctuation correctly, including end punctuation, commas, apostrophes, and quotation marks.	1	2	3	4	5					
Agreement of subject/verb and pronoun/antecedent.	1	2	3	4	5	6	7			
Verb usage—tense, voice, agreement.	1	2	3	4	5	6	7			
Use of modifiers—adjectives, adverbs, phrases, clauses.	1	2	3	4	5	6	7			
Spells and capitalizes all words correctly.	1	2	3	4						

* The full points were then divided by 2, and 50 points were given to the RAs written.

Used as the research data, the scores given to the participants' RAs were validated by two raters.

Also, another assessment rubric was brought for sharing by a participant whose work was actually assessed in one journal (Table 4).

Table 4. Actual referee criteria for publication.

Referee's evaluation		A. Recommendation (Please check appropriate option)
		Publish as is.
		Publish after optional minor revision.
		Publish after mandatory minor/major revision.
		I am not enough qualified to perform the review.
Yes	No	B. Checklist
		1. Is the manuscript of high scientific quality?
		2. Is the manuscript free from errors?
		3. Is the paper well organized?
		4. Is the title appropriate?
		5. Are the references to related work adequate?
		6. Is the English satisfactory?
		7. Are the figures clear?
		8. Are the tables clear?

Although this set contained, to some extent, unclear elements with respect to methods versus language quality, thus made the set of assessment too broad, it was included in the discussion as it was really used in science publication, where the participants learned what would be expected by reviewers. While the first rubric was used for research analysis, both were brought for class discussion, which helped the participants become aware that the process of translating their research knowledge into manuscripts was very crucial in terms of the discourse members' expectation.

This action well reflected the use of RA evaluation in this instruction as "the journey," rather than "the snapshot" (Klimova, 2011, p. 390), meaning that the results served as feedback for the participants to develop their ability more for satisfactory criteria.

Data Analysis

The data obtained in Phase One were quantitatively analyzed using descriptive statistics. The data collected in Phases Two and Three were analyzed quantitatively and qualitatively through mixed-methods analysis. The participants' writing development indicated in the pre/post-tests, their attitudes toward learning through the model, and the interviews were examined through t test, descriptive statistics, and qualitative analysis guided by Strauss and Corbin (1998), respectively. The member checking suggested in Creswell (2003) with two experts in science and some participants was implemented.

As has been discussed, the emphasis of this article is two-fold. First, the results revealing the participants' problems and needs derived from Phase Oneserve as the holistic context for the model constructed. Second, the data from Phase Three, which was confirmed by Phase Two data, are presented here as it represents the effective use drawn from the revised model retested for actual use in workplace training. Both research findings are shown here. It is noted that the Phase-Two data are omitted here as they were confirmed by the last phase data.

Results and Discussions

Research Question One

What Are the Participants' Major Problems and Needs in Relation to English Writing for Scholarly Publications?

Participants' Writing Problems

The problems in English writing for scholarly publication were analyzed through the participants' self-evaluation divided into groups based on their job positions. The data are illustrated in Table 4.

Table 5. Participants' levels of self-evaluated abilities.

Item	Areas of evaluation	Levels of self-evaluated ability					
		Weak (%)	Fair (%)	Good (%)	Excellent (%)	Mean	S.D.
1	knowledge of argument appeal	8.80	71.20	16.00	4.00	1.15	0.62
2	abilities in argument appeal	81.60	17.60	0.80	0.00	1.19	0.41
3	knowledge of sentence types	92.00	8.00	0.00	0.00	1.08	0.27
4	abilities in writing various types of sentence	26.70	72.30	1.00	0.00	1.74	0.46
5	awareness or knowledge of English text structures	53.60	29.60	9.60	7.20	1.70	0.91
6	knowledge in paragraph writing	28.80	52.80	12.00	6.40	1.96	0.81
7	skills or abilities in paragraph writing	38.6	54.50	6.90	0.00	1.68	0.60.
8	knowledge in essay writing	70.40	11.20	13.60	4.80	1.53	0.90
9	Abilities in essay writing	72.80	9.60	13.60	4.00	1.49	0.87
10	Link between development of essays and RAs	80.00	17.60	1.60	0.80	1.23	0.51
11	knowledge in writing English research papers with generic features	75.20	3.20	17.60	4.00	1.50	0.92
12	abilities in writing English RAs with generic features	74.40	7.20	12.80	5.60	1.50	0.92
13	confidence in writing English RAs with coherent development	80.00	12.00	8.00	0.00	1.28	0.60
14	confidence in writing English RAs with flow of thoughts	75.20	18.40	4.00	2.40	1.34	0.67
15	confidence in writing English RAS with science rhetorical style	80.80	14.40	3.20	1.60	1.26	0.59
16	confidence in content organization in English RAs with generic features	70.4	11.20	14.40	4.00	1.52	0.88
17	stress or anxiety in writing English RAs	14.4	54.4	23.20	8.00	2.25	0.80
Grand mean						1.57	0.53

N=125

1.00-1.74 = weak   1.75-2.49 = fair   2.50-3.24 = good   3.25-4.00 = excellent

The participants revealed strong problems in three major areas. A primary one is related to the notion of writing appeal, where they stated a weak level in knowledge and abilities in argument appeal (mean=1.15 &1.19). However, it was the fact that participants might understand notions of rhetoric of science, which is based on modes of inquiry, logic, and three appeals of argumentation including scientific practitioners' ethos, scientific publications' structure and scientific discourse's characteristic.

The second group of problems was of a similar pattern. They felt that their knowledge of and abilities in sentence construction and text patterns were quite low. The majority of participants stated their perceived knowledge and abilities in paragraph writing at a fair level (means=1.96, 1.68), and a weak level in knowledge and skills in essay writing (means=1.53, 1.49). At the third level, they expressed weak abilities in all elements of scholarly writing, a higher order of writing skills. Their knowledge in and abilities of RAs generic structures were quite deficient (a 1.50 mean each). Not surprisingly, their confidence in writing English RAs with coherent development, flow of ideas expressed, scientific rhetorical style and content organization in English RAs with generic features was quite low (means=1.28, 1.34, 1.26, &1.52). They also demonstrated a moderate level of stress or anxiety in writing English RAs.

For more specific results that could uncover such problems more precisely, the same aspects of such areas of evaluation were compared in three groups of the participants based on their job positions and areas of work—research assistants in social science and in science, and researchers in science.

Table 6. Three specific groups' levels of evaluation ability.

Groups of participants	Grand Mean	S.D.	Interpreted results
1 (30 research assistants in social science)	1.24	0.13	Weak
2 (74 research assistants in science)	1.45	0.37	Weak
3 (21 researchers in science)	2.44	0.45	Fair

The results showed a greater grand mean of researchers in science (2.44) than that in research assistants in science (1.45) and in social science (1.24). This verification was strengthened through the paired t-test, comparing the difference of perception in their ability between the research assistants in science and social science due to their shared positions as research assistants, and between the researchers and the research assistants in science due to their shared areas of work. There was no statistical difference in self perceived abilities among the research assistants in both areas. Both perceived their ability in scholarly writing as weak. However, when comparing the science researchers' grand mean (2.44) to that of the research assistants (grand mean=1.45) in the same areas, the difference was significant, indicating the very low perceived ability in the research assistants in science.

What explains these results could be the education background of each group. For example, the researchers' who earned a Doctorate from an English speaking countries lent them more opportunities to use English naturally in authentic contexts than the research assistants' who had only the opportunity to earn Masters from non-English-speaking study programs in Thailand. What confirms the importance of educational background is the result showing that the research assistants in social sciences were only exposed to English writing while in college, thus resulting in their limited English abilities, as data obtained from interviews show:

> English is not official language in Thailand, so it's not easy to write English publications well. Thai people are not skill to speak, write in English language when compare with neighbor country. Thai people who not

graduated foreign country gave a little practice to learn writing/speaking in English language. I think if I have many training, my writing publication English will be development. I expect that teacher will correct it; then, I become confident to do it. (Original interview transcription, Piy)

I felt that it was quite difficult for me to write in English—to write as what I actually thought, to write grammatically correct, and to write for communicating ideas with an audience successfully. (Translated interview transcription, Sur)

Also, the most severe problems the research assistants perceived could be on account of their lack of exposure to academic English literacy in their education. This could cause them not to fully acquire writing abilities sufficient for their text production. To put it another way, their lower exposure in English could result in the same pattern of their awareness in how language is used in certain purposes like research publication. With such a lower level of language awareness, they could resort to the writing convention of their mother tongue. This was witnessed in this research and several studies indicating wiring problems and sociopolitical issues in the process of knowledge production of researchers in science in periphery countries like Poland (Duszak & Lewkowicz, 2008), Venezuela (Salager-Meyer, 2008), Sudann (ElMalik & Nesi, 2008) and Italy (Giannoni, 2008).

Related to this are the deviating texts found in various aspects. At a primary level, language mistakes in non-native writers' texts are considered commonly consistent mistakes occurring in the areas of general grammar, composing incompetence, academic citations, academic voice, knowledge claims, metadiscourse, hedges, and cultural barriers interfering with writing processes (Adams-Smith, 1984; Bazerman, 1988; Dudley-Evans, 1994; Johns, 1993; Mauranen, 1993). Surprisingly, the problems in such basic literacy were even commonly found in the participants holding doctorates from English speaking countries who also revealed language difficulty in publication (e.g., Cho, 2004; Tardy, 2004), although they felt more confident than those pursuing the degrees in non-English environments.

Participants' Needs in Writing for Scholarly Publications

The participants' needs in scholarly writingwere then investigated through the self-reported survey in three specific groups, as shown in the following result.

Table 7. Three groups' level of need for scholarly-writing improvement.

Item	Need of improvement	Social science RA (Group1)		Science RA (Group 2)		Science researchers (Group 3)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
1	academic English grammar	3.07	0.69	3.36	0.73	3.29	0.71
2	vocabulary, right, effective words	3.13	0.62	3.20	0.75	3.29	0.78
3	academic expression	3.30	0.75	3.32	0.77	3.57	0.67
4	sentence patterns	3.53	0.62	3.69	0.68	3.90	0.30
5	advanced sentence patterns	3.97	0.18	3.80	0.49	3.86	0.35
6	skills in paragraph writing	3.73	0.58	3.73	0.62	3.90	0.30
7	skills in essay writing	3.77	0.56	3.74	0.62	3.86	0.35
8	skills in English RA writing	3.97	0.18	3.74	0.62	3.95	0.21
9	transitions used in writing	3.57	0.62	3.68	0.64	3.81	0.40
10	thoughts spontaneously expressedthrough writing	3.90	0.30	3.85	0.35	3.86	0.35
11	writing without direct-translation mistakes	4.00	0.00	3.85	0.35	3.90	0.30
12	writing strategies for academic purposes	4.00	0.00	3.88	0.32	3.90	0.30

Item	Need of improvement	Social science RA (Group1)		Science RA (Group 2)		Science researchers (Group 3)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
13	practical models of effective writing	4.00	0.00	3.88	0.32	3.76	0.43
14	good examples of professional writing needed	4.00	0.00	3.82	0.38	3.86	0.35
15	writing effectively based on norms of native speakers	4.00	0.00	3.95	0.22	3.95	0.21
Grand Mean		3.73	0.25	3.70	0.41	3.05	0.65
Interpreted results		Strongly need		Strongly need		Moderately need	

Group 1 (N= 30),   Group 2 (N= 74), Group 3 (N= 21)

Like the results revealing the participants' problems related to scholarly writing, the research assistants in social science and hard science showed strong levels of such needs with high grand means, 3.73 and 3.70. This could relate to the quite low levels of English writing abilities shown in the participants' felt problems discussed earlier. However, the researchers in science needed to improve their scholarly writing skills moderately (grand mean=3.05). This is not surprising as these researchers used academic scientific English as a result of their overseas graduate studies.

For the participants' specific needs, the research assistants in both disciplines expressed the highest needs to improve any skills associated with scholarly writing, the mean with 4 and 3.7-3.95 in social science and science, respectively. Both the social science and science groups also needed help with writing skills in paragraphs and sentence patterns with high mean values, 3.53-3.90, and 3.69-3.85, respectively. all of these data indicated that the research assistants in both groups need the model designed for all sub-skills for writing for publication. These data reflected the primary obtained from the pre-study interviews, in which the language complexity included all levels of writing, sentence patterns, paragraphs, essays, and RAs, come into play. This, once again, could explain why the participants found in the literature (e.g., Cho, 2004; Curry & Lillis, 2004; Flowerdew,1999a, 1999b) perceived themselves negatively and their manuscripts were considered of low quality (Flowerdew, 2001; Gosden, 2003; Misak, Marusic & Marusic, 2005). The participants' painful experience has shown that writing for publication, or even its lower levels, was very difficult. All related skills of this kind of writing are more complex, especially writing in English as their L2 or additional language, meaning that the disparity between their mother tongue and English could become barriers for publishing their research endeavors. What has been involved here certainly indicated the need to help these professionals to survive in their working disciplines. Given that science and technology is a mechanism that makes the country move, as endorsed by a large number of the studies in various fields, the model I would construct in this research should aim to help those in science disciplines with the expectation that the research results could play a part of development of science and the country.

To investigate how the instructional model helped solve to some extent the problems our Thai professionals have encountered, I needed to examine the effects of explicit instruction on the participants' writing competence in all related levels. After the model's effectiveness was validated through the research findings of Phase Two (N=25), the model was modified in a few aspects, such as introducing more authentic RAs in science-related fields, incorporating certain elements of voice closely associated with science RAs, and including more participants (N =30). The following research finding is drawn from Phase Three and treated as the finding that

indicates the effectiveness of the instructional model finally tested as a result of some refinements suggested by its first testing in Phase Two.

Research Question Two

What were the effects of explicit instruction on the participants' writing abilities?

In Phase Three, the effectiveness of the invented model was retested as the final step for the R&D design used in this three-phase research project. Here, the participants (N=30) were trained to write for scientific publication, and their writing gains would be inferred as the effectiveness of the model was retested in the third phase. As a result, the participants' pre-and post tests, and RAs written during the workshop was examined, both functioning as triangulation of this finding.

Pre-and-Post-Test Results

The pre-and-post tests were used as the primary data source to examine the extent of writing competence the participants gained after the instruction. Validation of the scoring process was conducted by two raters.

Table 8. A comparison of the participants' pre- and post-test scores evaluated by two raters.

Test	Rater	Mean	S.D.	t	Sig.
pretest	researcher	4.60	0.77	-0.34	0.74
	co-rater	4.67	0.76		
posttest	researcher	7.57	1.38	0.40	0.69
	co-rater	7.43	1.19		

N = 30; *p*>0.05

The pre-and-post-test papers were assessed through rubric assessment regularly used in the paragraph writing course of my university, where quality of ideas (25%), organization (35%) and language (40%) are taken into account. The data by the two raters illustrate the consistent scores in the pretest and the posttest, indicated by the significance levels of the two tests assessed by two raters as greater than 0.05. This process was treated as the reliability of the scoring procedure performed in the second and third phases of this research.

Indicated by the data from the pretest and the posttest papers, the participants became more advantaged as they were trained to write paragraphs as a fundamental builder for writing in a more advanced level like RAs, shown in the following samples.

(1) Pre-test sample
Problems of Thai Researchers
Writing in English, it is quite hard for me. In writing journals, I know and understand what I will write, but I don't know how to write it in English. Even I could write those sentences in English, but it lose the meaning when it be translate to English. Sometime I am going to write paper, but I can't remember the word in English that I have known before. All the problems happen because I am Thai, and I think, speak and write in Thai language all times. The problems have still existed, but I am going to fix it by directly learn how to write journal in English. (Tri)

(2) Post-test sample

Problems of Thai Researchers

Writing in English is quite hard for me. First, in writing journals, in the past I did not know how write although I knew what I wanted to write. However, I learn many things from the workshop. I know how to write good paragraph, essay and journal although my writing is not good enough now. Second, I still cannot write sentences that have the same meaning that I want to say 100%. However, I know the patterns of sentence and clause that I saw a lot in journal but did not know it in the past. Although I am not good enough now, but I feel better. Because I know what you call 'rhetorical convention, generic feature of research article. Now I think being Thai is not problems because I learn how to write all type from paragraph to be journal. (Tri)

Also, the interview data, (5), pointed out some improved aspects, especially in the flow of ideas expressed through the paragraphs written in the pre-and-post-test papers. The writer reflected on his problems and, through his work sample, told us how he needed help, as can be seen by his voice here.

Writing in English, it is quite hard for me. In writing journals, I know and understand what I will write, but I don't know how to write it in English. Even I could write those sentences in English, but it lose the meaning when it be translate to English. Sometime I am going to write paper, but I can't remember the word in English that I have known before. After workshop, I feel happy. Because I can write better. I have fixed moves in the paper parts and I know what we are expected by the editors as you said in teaching. Thank you for your help. (original interview transcription, Tri)

These test samples, as well as others, explained well how the participants had improved overtime. As the workshop was aimed to coach the participants to write professionally, I also investigated how well they could write RAs, the later component of the model.

Research Articles

In addition to the pre- and post-test results, the participants' RAs written during the research participation was analyzed. For practicality on account of their time constraints, I opened more room for their selected papers. The RAs for this analysis included those they wrote while in the workshop, those available as their lab reports, and those rejected elsewhere, all of which were treated as their first draft for this study. Although these did not seem to be equal in terms of how each arrived with his or her first draft, the disparity did not affect my analysis as the participants had to revise all their papers after they were taught to write each part of theRA, where the gap between draft 1 and their revision was considered for their abilities in scholarly writing.

The participants were taught to write paragraphs so they learned how thoughts could be developed and translated to paragraphs, then extended to essays as their arguments could scaffold them for RA practices. After practicing essays skills, they were guided to observe ways in which thoughts were organized and developed to RAs.

They observed that the development of essays and RAs seemed to be similar to an hourglass shape. The introduction is like cone-shaped moving from the wider general to the narrower specifics that address the thesis statement and the RA research objectives. The essay

body paragraphs and the Methods, Results describe any elaborated thoughts in the middle sections. The triangle-shaped essay conclusion and RA Discussion restated or echoed the focus at the initial position and concluded with the general final thought for essays and the real-world practices for RAs. They were amazed that essays on a college level, with which they still missed opportunities to learn, share the same development with the A-I-M-R-D convention of RAs, although audience and the amount of content for writing of both levels are different. Observing and drawing the moves or rhetorical conventions of each RA section from the published RAs selected as the criteria previously stated, the participants could understand certain moves required in RAs. This process was followed by comparative analysis with three substantially leading RA frameworks in science publication—Kanoksilapatham (2005), Swales and Feak (2012) and Weissberg and Buker (1990), used as generic features so the participants could consult these frameworks as the guidelines, in which they could adopt or justify the moves and steps appearing in such frameworks to best suit their research disciplines. Their practice started with Materials, Methods, and Results, and moved on to Introduction, Discussion, and Abstract, according to the complexity levels of each part and the nature of their lab research, and they normally performed lab tests before writing them. The RA length was not fixed but allowed the participants to decide based on their actual practice. As such, the length of their RAs, single spaced, Times New Roman 12, was roughly 4-7 pages, not including references. The RAs were evaluated, section by section to accommodate the manner of actual teaching, in terms of the moves and steps required in the genres of each article section, in conjunction with some actual rubric the participants brought, the rubric really used in assessing the work they co-authored with their supervisors in the labs. The quality of the articles was used to identify the participants' abilities in scholarly writing and thus to infer the effectiveness of the instructional model. This reveals how the participants wrote their RAs while being trained to write scientifically through the invented model.

In this examination, the first and the second drafts of the RAs were analyzed. However, the reliability of the scores by the researcher needed to be examined. In this process, the participants' second drafts were consequently assessed by the researcher and another rater, with the results reported here:

Table 9. Participants' revised writing tasks scored by two raters.

RA Sections	Drafts	Mean	S.D.	t	Sig.
1. Abstract	researcher	6.53	0.90	-0.71	0.48*
	co-rater	6.70	0.92		
2. Introduction	researcher	7.03	0.72	-0.16	0.87*
	co-rater	7.07	0.87		
3. Method	researcher	7.10	0.80	-0.33	0.74*
	co-rater	7.17	0.75		
4. Result	researcher	7.57	0.50	-0.79	0.43*
	co-rater	7.67	0.48		
5. Discussion	researcher	7.57	0.50	-1.44	0.16*
	co-rater	7.77	0.57		

N= 30

As shown, there was no statistically significant difference between the scores by the raters ($p>$ 0.05), indicating that the scores given by the researcher were reliable.

Then, the results scored by the researcher were used as the data inferred as the participants' development in RA writing, in which the first and revised (second) drafts were compared, as illustrated in the following table:

Table 10. A comparison of the participants' RAs first and revised drafts.

RA Sections	Drafts	Mean	S.D.	t	Sig.
Abstract	draft 1	3.90	0.71	-10.88	< 0.05
	revision	6.53	0.90		
Introduction	draft 1	4.13	0.86	-14.52	< 0.05
	revision	7.03	0.72		
Method	draft 1	4.63	0.77	-13.40	< 0.05
	revision	7.10	0.80		
Result	draft 1	4.57	0.77	-18.06	< 0.05
	revision	7.57	0.50		
Discussion	draft 1	4.03	0.77	-18.02	< 0.05
	revision	7.57	0.50		

N= 30

The participants' score average of the revised RAs was greater than that of their first drafts significantly ($p< 0.05$). The same statistical pattern occurred in all RA parts and the whole paper. This indicates that the participants could improve their abilities in scholarly writing demonstrated in the whole RAs as a result of their participation in the instruction conducted for this research.

Below is an RAs' excerpt, where the writer stated ideas written in Thai and translated into English. The participant's identity in relation to workplace, xxx and yyy, are masked here.

(3) First draft sample
Methodology of Management to Increase R&D Projects in Thai SMEs
Introduction

วิทยาศาสตร์และเทคโนโลยี (วและท) เป็นปัจจัยสำคัญปัจจัยหนึ่งในการขับเคลื่อนให้เกิด global economy วและทเกิดจากการทำ R&D ที่ไม่หยุดนิ่งสร้างสรรค์นวัตกรรมและพัฒนาปรับปรุงให้ดีขึ้นการสนับสนุนให้เกิด R&D ใน ภาคอุตสาหกรรมจึงเป็นพันธกิจหลักด้านหนึ่งของรัฐบาลที่ได้ดำเนินการมาอย่างต่อเนื่องแต่ณปัจจุบันการทำ R&D ของ ค่อนข้างน้อยมากยกเว้นในบริษัทใหญ่หรือบริษัทข้ามชาติ

xxx เป็นหน่วยงานในสังกัด yyy ที่ทำหน้าที่สนับสนุนการทำ R&D ใน SMEs มาเกือบ 20 ปีเพื่อช่วยแก้ไข ปัญหาด้านการผลิตเพิ่มประสิทธิภาพการผลิตและสร้างผลิตภัณฑ์ใหม่ให้ SME อย่างไรก็ดีจำนวนโครงการ R&D ที่เกิดขึ้น เมื่อเทียบกับจำนวนโรงงานอุตสาหกรรมของประเทศไทยนับเป็นสัดส่วนที่น้อยมาก

Science and technology (S&T) is one of the main important factors for driving bussiness to the global economy. S&T comes from doing the dynamic research and development (R&D), creating the innovation, and improving. Then R&D supporting in the Thai Industrial sector or SMEs is the contineous mission and policy of Thai government. However, R&D is ignored by SMEs except multination companies.

xxx is under yyy. Almost 20 years, xxx support R&D projects for Thai SMEs to do problem solving, increase productivity and develop new products, which focus on the product

differentiation or creat value-added products. However, the portion of R&D projects was done in SMEs compare with the number of factories is very low. (Wap's first draft)

As appearing in the excerpt, the content drafted in Thai was quite logical and coherent, and this resulted in the same pattern in its English translated version with some problems in flow of connected ideas, regardless of simple grammatical mistakes sporadically occurring throughout the RA and its excerpt. However, this was not considered unfavorable although the translation could indicate the writers' lower abilities in writing. Learning in the workshop, the writer, though still resorting to translation, could in the first place have spelled out her intended meaning into English better, and subsequently revised the draft with three moves as required in the introductions section, as in her revision, shown here:

(4) Second draft sample

Management Methods to Increase R&D Projects in Thai SMEs
Introduction
To highlight the significant role of R&D, xxx, an agency under yyy, supports R&D to achieve its mission on SMEs. Over 20 years, xxx has supported financial and experts for Thai SMEs to solve problems, increase productivity and develop new products, all of which focus on the product differentiation or create value-added products. However, the portion of R&D projects, compared to a number of Thai factories, has been investigated in SMEs in a low degree. More seriously, invitations of SMEs to increase R&D projects are still problematic.
Therefore, the main purpose of this paper is to offer suitable methods of management to increase R&D projects in SMEs via two approaches, support individual companies and industrial sectors. We believe the findings will provide the greatest solution on how xxx helps industries and subsequently produces practical, influential research and development for Thai SMEs. (Wap's second draft)

Despite some ungrammatical mistakes, this revision appeared to be accepted more by the generic features of the Introduction section, where the writer clearly indicated the central ideas in the opening sentence, the gap indicating the need for the current research, and the main objective of the study, all of which were quite a bit more coherent, compared to her first draft.

The participants' abilities in scholarly writing can be explained by the elements forming the instructional model. First, the model encouraged the participants' linguistics knowledge, writing skills in discourse levels including paragraphs, essays and RAs, and assisted them to gain writing abilities. The sentence patterns including subordination, non-finite clauses, prepositional phrases, pre-modification of nouns, as mentioned in Biber (2006), and Carter and McCarthy (2006), were very difficult for the participants in the first place as the sentences they wrote were sometimes found to include lack of knowledge in not only thoughts translated into correct forms with certain sentence markers, but also reduced forms of complex sentences. However, the teaching with emphasis on academic linguistic skills could make them aware of the meaning of science content and sentence patterns to accommodate such logical thoughts more satisfactorily. The excerpts below showed their problems: (5) and (6) exhibiting limited skills in sentence combining; the others, their confusing or incomplete thoughts:

(5) The study of graphic symbols in AAC has primarily focused on an analysis of symbol learnability and complexity and grouped in terms of iconicity. Researchers studying symbols frequently refer to the iconicity of the symbols. Iconicity refers to the visual relationship of symbol of its referent and varies along a continuum from transparent to opaque. (Sar)

(6) Some of existing works only suggested a list of refactoring without ordering and the others suggest refactoring sequences. However, these works do not include the criteria. Therefore, our research problem is "Can we find an optimal refactoring sequence that removes the bad smells, uses the least effort to understand refactored code and improves the maintainability?" (Pan)

(7) These urge the development of the prosthetic components in the country. The polycentric four-bar linkage knee prosthesis project was collaborated aaa, bbb, and ccc developed the polycentric four-bag linkage knee prosthesis prototype started in 2008. (Jak)

　　　　(aaa, bbb, and ccc used to mask the participant's identity)

(8) To create Thai AAC software like Mindspeak application, the project 'Thai Picture-Based language system for Persons with Communication Disorder' is considered to employ ECO PASS software, one of many kinds of AAC devices produced by PrentkeRomich Company to be a model. (Sar)

Second, while being trained, the participants learned to plan more for their thoughts to be woven into effective sentences conveying their intended meaning. The following sample, (9), was the less effective work with less-planned thoughts that could not attract readers.

(9) The physical rehabilitation for these groups of people is important to maximize their capability, promote independent living, return them to the society and have good quality of life under individual's circumstance.(Jak)

Related to the participants' planning are logic elements. The participants, after being trained to write academically through the model, witnessed that one of the most important elements of writing is logic. Among the impressive areas the participants expressed after the instruction, logical thoughts conveyed to sentences and more advanced levels of writing were viewed as a primary requirement for writers in science. The instances below, (10) and (11), showed the participants' problems in organizing content that may have made audience unable to follow their actual meaning:

(10) CO_2 from the Roi Et green Plant is from biomass combustion and hence, being part of the global carbon cycle, does not contribute to global warming. This is a distinct advantage of biomass-based production. (Neu)

(11) Current available methods for determining the fungal resistance of synthetic polymeric materials such as ASTM G21 and JIS Z 2911, have

the disadvantage in time-consuming in order that the visual fungal growth is shown. (Ked)

In my view, these logical thoughts in science apparently play a primary role, probably with a greater or, at least, equal degree compared to the elements with language, in creating any types of levels of academic texts as they function as the solid content to be communicated in most research disciplines.

Fourth, the model was helpful for those with difficulty in skills in making argument through logical sentences and the flow of connected ideas. Also, it helps those normally orientating their readers through the inductive approach, when they are developing ideas or arguments in paragraphs, to witness that the same ideas with the deductive approach became more effective as they could serve native English speaking readers more. For example, the sample (12) demonstrates incomplete thoughts, reflecting high-context collectivist culture in that incomplete meanings can be understood by the interlocutors sharing the same context (Gebhard, Graber, Grote, Miller, Thongrin, & Rodriguez, 1999; Hofstede, 2001; Triandis, 1994). Also, the idea in the sentences between inter-move shifts was not completely connected. The next sample, (13), exemplifies paragraphs inductively written unnecessarily; the last, (14), written without a clear point.

(12) Thai Government Pharmaceutical Organization (GPO) has started the first vaccine production in pilot plant-scaled level and has purchased 2 million doses of pandemic inactivated vaccine from the Sanofi-Pasture company while high priority groups of population is 4 million people. Lacking of the facilities and know-how of industrial-scaled influenza vaccine production, our country will have not the self-reliance for the emergency of the pandemic. (Sup)

(13) Not pattern such influences on the perception of graphic symbols, but also the influences on culture will be considered. Culture is generally defined as a set of behaviors, institutions, beliefs, technologies and values invented and passed on by a group of individuals to sustain what they believe to be high quality of life and to negotiate their environments (Taylor and Clark, 1994). To sum up, culture is a perceptually shared reality, a world view (Bloomer, 1990, p. 16). Moreover, culture undeniably dictates to a significant extent the material an individual is familiar with, whether the individual attends school, whether individual operates from an oral or literate state of mind and whether individual had previous experiences with symbols, and what thinking style individual utilizes. It seems that culture will have an influence on the perception of symbols (Haupt, 2001). Culture consequently influences on the patterns of communication. (Sar)

(14) The number of worldwide media Tablet sales to the end users was approximately 19 million unit in 2010, and expected to be 54 million by 2011. The survey assessed buying intent showed that the top ranking

devices which Americans would like to buy are smartphone, laptop, desktop PC, mobile handset, e-book reader, media tablet, respectively. In general, the mobile application refers to the application that runs on smartphones or other mobile devices. These mobile applications store downloads were forecasted to reach 17.7 billion downloads in 2011, which make up to 117% of 8.2 billion downloads in 2010. For a visible instance, currently Apple announced that its App Store had hit 10 billion downloads (from 300,000 apps for Apples iPhone, iPad, and iPod Touch). (Sum)

In these examples, the writers could have relied more on on-going development with unclear centrality. This became more severe as the writers could not make a point and failed to connect paragraphs in terms of logical ties. However, such phenomena prevalent among the participants could be handled better when the participants were trained to write in English, starting from logical sentences to systematic paragraphs, essays, and research articles. Below, (15), is a paragraph written with on-going explanation, and its revised version, (16), finally published in the field journal of a participant:

(15) (Earlier draft)
Fig.8 represents the results of the thermal conductivity (k) of the non-doped $CuAlO_2$ sample from 300 K (room temperature) to 1000 K. The results showed that the values of thermal conductivity were decreased with the range from 3.5 to 1.5 W/mK with measuring temperature from 300 to 1000 K respectively. The maximum value of k was 3.48 W/mK at room temperature and minimum value was 1.5 W/mK at the range temperature from 800 to 1000 K. These results exhibited that the thermal conductivity of the non-doped $CuAlO_2$ sample were decreased depending on increasing temperature. Therefore, the maximum value of Figure of Merit ($Z = P/k$) and dimension less ZT ($= P/k$) of the non-doped $CuAlO_2$ was occurred in high temperature because the k contained the minimum value. (Zha)

(16) (Revision)
Fig.8 shows the thermal conductivity (k) of the non-doped $CuAlO_2$ sample from 300 K (room temperature) to 1000 K. It is measured by using a laser flash method with the relation $k = dC_p a$, where d, C_p and a are the same density, specific heat and thermal diffusivity respectively. The results of k value are the range from 3.5 to 1.5 W/mK in temperature 300 to 1000 °K respectively. These results shows that the thermal conductivity of the non-doped $CuAlO_2$ sample at room temperature is decreased depending on increasing temperature. Thermal conductivity of non-doped $CuAlO_2$ sample at room temperature is 3.48 W/mK as leading to the value of the Figure of Merit (Z) and dimension less ZT are 2.8045×10^{-11} K^{-1} and 0.85×10^{-8} respectively. This value exhibits that it has small that is $Bi_2 Te_3$($ZT=0.615$) [21] and $NaCO_2O_4$($ZT=0.08$) [22] at room temperature. (Zha)

Last but equally important, the participants learned through the model to observe the leading frameworks I used as generic features (e.g., Kanoksilapatham, 2005; Swales & Feak, 2012; Weissberg & Buker, 1990) so they could write RAs in their disciplines in a quite flexible manner. In fact, the participants worked in various disciplines, such as microbiology, applied physics, biochemistry, nanotechnology, materials sciences, computer sciences, and the like, but the generic feature of RAs can be of help as the structure, though in different academic discourses, can more or less share such generic features for experimental studies (see Samraj, 2008). As such, observing RAs written through the generic features based on these flexible frameworks can help them justify what works and what does not in their own field. The use of metadiscourse or some lexical bundles applied in science was also found useful for their reader-friendly, coherent writing in science as it was reported as an unknown area in their research publication. What is more helpful is the actual work we took from some journals with high impact factors, such as *Science*, *Nature*, *British Medical Journal*, *Journal of the American Chemical Society, Green Chemistry, AngewandteChemie International Education, Advanced Energy materials, Catalysis Today*, and the like, through which they can learn to observe real practice in their field and across others so they implement these practices in their work more substantially. With the guidelines and continuous feedback I always offered in the workshop, the participants could demonstrate their skills in RA writing**.**

As a result, the ethnographic skills I taught for the discovery of genre patterns, where one observes actual journals of any target discipline for any discourse patterns, can help them in any quest of knowledge. What they always need to do in their real world is to investigate generic features and certain linguistic use of the RAs in their discipline. For any local grammatical mistakes, although some unacceptable grammatical errors may still appear in their manuscripts, they were very happy working as ethnographers observing actual use of language from the published RAs, and English corpus concordances (http://www.lextutor.ca/conc/eng/ & http://corpus.leeds.ac.uk/protected/query.html), where they could often correct language mistakes on their own, adopting or applying some patterns most frequently occurring in the concordance lines.

Research Contribution

Implied by the findings, such writing-related problems mentioned as the main obstacles for non-native professionals in previous studies (e.g., Benfield & Howard, 2000; Burrough-Boenisch, 2003; Carter-Sigglow, 1996; Casanave, 1998; Curry & Lillis, 2004; Li, 2002; Liu, 2004; Misak, Marusic, & Marusic, 2005; Wood, 1997a) could be sorted out by a number of ways, one of which is the provision of explicit instruction. It is clear that working on basic language areas like sentences and clauses work well to help lessen such severe problems, as evidently displayed in the study. In fact, the SWB model I used in training to write scholarly publication for the participants contains six important elements. In line with the studies by Eskey (1983) and Rosenthal (1996), the participants' academic linguistic skills were improved as the first fundamental for more sophisticated skills for writing. Without knowledge and skills in important structural patterns, it would be very difficult for Thai professionals to express their argument in written forms. The abilities to use such structures, and awareness of text structures and language used by native writers through the observed instances derived from published RAs and English concordance certainly play important roles as the writers can use such elements in the composing

stages, the next elements for writing paragraphs and essays, the bridging skill to RAs writing, as they at these two levels should hold strong knowledge and abilities required for RA writing. The processes of learning to write RAs that was accommodated by the use of published RAs and the frameworks as generic structures by Kanoksilapatham (2005), Swales and Feak (2012), Weissberg and Buker (1990), and others frameworks with some adjustment for their research discipline were found positive. Also, the instructional stages with RAs and metadiscourse devices, such as the use of hedges in knowledge claiming, were remarkably helpful for them to write their RAs more effectively. While writing RAs with certain communicative functions of each RA section, the participants could observe and analyze lexical choice, rhetorical features of genres and other communicative functions, and thus recognize these elements and transfer such competence to RA writing. The processes of genre pattern discovery during these sessions were quite complicated as the writers need to understand their contexts that then highlight linguistic and rhetorical features of the texts. For effective instruction, the approaches of the contextual meaning of their disciplinary RAs, viewed here as top-down processing, and the linguistic, rhetorical knowledge, the bottom-up elements, consequently need to work interactively. The fact that the participants were taught to write RAs associated with their disciplinary practice with observation in the published RAs and the generic structure frameworks that were flexible and applicable to their work indicated that the instruction aimed to allow the participants to reflect ways in which RAs writing could be achieved—exploration, observation, and learning to write, rather than being straitjacketed by the rhetorical moves of RA frameworks. This flexible use could help the process of their learning to write academically to become quite dynamic, reflecting the combination of such top-down and bottom-up approaches, the former encouraging them to explore the writing context of their own and the latter allowing them to look into a wide range of language in relation to academic linguistic skills, RA rhetorical conventions, and certain linguistic features used in particular purposes of each RA section. With this awareness, the explicit instruction, when in further use, would allow further justification in relation to its related elements, and their sequence and interactive use so, the SWB model could correspond to the trainees or learners' needs and certain backgrounds, such as English proficiency, work status, time availability, and so on. As has been discussed, the instructional model with the elements drawn from all related empirical sources should be of use to those related parties—researchers in applied linguistics, teachers of ESP/EAP settings, and those in charge of professionals' development in scholarly writing of workplaces.

Conclusion

Despite some study limitation in terms of more access to the participants in Phase One, and some notion of control in Phases Two and Three, the findings suggest that the instructional model constructed on the basis of the participants' historical backgrounds and the use of relevant literature can be put into effective us. The non-native novice professionals were found to gain knowledge and skills in scholarly writing. The finding of this study could explain why the non-native scholars documented in the literature review had difficulties in publishing their manuscripts. In addition to the absence or lower levels of their awareness of the rhetorical structure and linguistic features (Swales,1984; Swales & Feak, 2000), lack of training to write for scholarly purposes come into play. When writers lack generic features for academic text production, or the appropriate academic schema, they thus need to be sensitive to the complexity and variation of academic conventions, in which the awareness of such genres (Holmes, 1997)

and the explicit instruction, like what was accomplished in this study, are truly required. To publish their works in international journals, where English is required as an international language with Anglo-American norms, style and conventions, these non-native apprentices should not feel that they are at a linguistic disadvantage any more. Rather, they, as informed by these research findings, should be motivated to practice with all the elements the Scholarly Writing Builder model suggested so they could become confident members working and writing for their academic discourse. Here, their experience in science supported by scholarly writing abilities could embody their transformative potentials as experienced research assistants that will, after all, serve as future researchers.

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