L1 domain-specific knowledge as predictor of reading comprehension in L2 domain-specific texts: The case of ELT student teachers

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Abstract: The present study examined the effect of L1 domain-relevant knowledge on L2 reading comprehension texts among student teachers of ELT (N = 90), drawn from a population of 270 student teachers studying at an undergraduate program in some state universities in Iran. A proficiency test was applied to control language proficiency of students. Among them, those whose scores were one standard deviation above and below the mean were selected and divided into three different groups based on their L1 majors (mathematics, humanity and natural sciences). A 90-item test consisting of three domain-relevant subtests was constructed, validated and used to elicit the data. As for the test characteristic variable, the text difficulty of all the passages was also controlled for. The results generated from descriptive statistics, one-way ANOVA and follow up Scheffe tests revealed that domain-relevant texts influenced reading comprehension to a greater extent than domain-irrelevant ones. The implications for language teaching and material development are discussed and some suggestions for further research are offered.

Subjects: Language & Linguistics; Language Teaching & Learning; Literature

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PUBLIC INTEREST STATEMENT
Within the last two decades research on L2 reading has been substantially focused on “reading to learn” as opposed to “learning to read” (Jacobs, 2008, p. 12). One way that “reading to learn” can be enhanced is integrating readers’ pre-existing knowledge about the text content with the new knowledge. The present study examined the effect of first language subject matter knowledge on second language reading comprehension texts among student teachers. Findings indicated that first language subject matter knowledge can improve learners’ reading comprehension texts related to their own subject matter. However, based on this study’s findings, some important points should be considered. First, level of specificity of subject-related texts should be seriously considered in future studies. Second, material writers can design English course books in line with student teachers’ first language major. This can promote their motivation. Third, reading instruction is content-centered and prior topic knowledge makes reading purposeful.
1. Introduction
Within the last two decades research on L2 reading has been directed toward L2 learning and education. That is, it has been substantially focused on “reading to learn” as opposed to “learning to read” (Jacobs, 2008, p. 12). One way that “reading to learn” can be enhanced and facilitated is integrating readers’ background knowledge (pre-existing knowledge about the text content) L2 readers’ bring with them to the reading task with the new knowledge (McNamara, Kintsch, Songer, & Kintsch, 1996). Investigating such a link between pre-existing knowledge and the existing knowledge among L2 readers has been considered as an important part of reading research (Pearson, 2009).

Previous studies of background knowledge have substantially focused on the link between L2 cultural knowledge and its effect on L2 learners’ reading comprehension (e.g. Droop & Verhoeven, 2003; Goldenberg, Rueda, & August, 2006). Findings from such studies indicate that cultural relevant texts improve L2 learners’ reading comprehension to a great extent. However, it is claimed that not all of the comprehension difficulties L2 learners may face are associated with cultural relevant knowledge they transfer to reading task (e.g. Rydland, Aukrust, & Fulland, 2012). As Xiao-hui, Jun, and Wei-hua (2007, p. 18) rightly put it “the knowledge of what type and genre the text is can facilitate reading comprehension for readers because the type of the text will offer detailed evidence of the content of the text”. This type of knowledge which is called prior topic knowledge-an important type of background knowledge which comes from a single text (Alexander & Jetton, 2000), is reported to affect reading comprehension to a great extent (e.g. Alexander & Jetton, 2000; Best, Floyd, & McNamara, 2008; Cunningham & Stanovich, 1997; Samuelstuen & Braaten, 2005). For example, a student who has studied biology as his main field of study in his/her L1 while in secondary school may apply this topic knowledge to similar biology-related texts of reading comprehension in an L2 context and this may affect his/her ability in reading comprehension.

While various studies have examined how L2 topic knowledge affects reading comprehension ability (e.g. Donin & Silva, 1993; McNamara et al., 1996), little is known about how L1 domain-related knowledge determines L2 reading comprehension across L2 domain-specific texts, when language proficiency of participants and the readability of L2 reading passages are controlled for. Therefore, the current study aims to attend to this void.

2. Review of literature

2.1. Types of prior knowledge
Prior knowledge contributes to readers’ compensation for incomplete text-based information within existing texts by easy and quick access to prior domain-related information stored in readers’ long-term memory (Ozuru, Dempsey, & McNamara, 2009). Prior knowledge can be viewed and interpreted from three differing ways: Prior topic knowledge, prior domain knowledge and prior general knowledge (Alexander, 2003; Goldman & Rakestraw, 2000). Prior topic knowledge is an important type of background knowledge which the readers bring to the reading task from a single text, while prior domain knowledge may exist as a result of diachronic exposure to multiple sources of texts (Alexander, 2003). Prior general knowledge, on the other hand, is that type of knowledge a reader may have about the structure of a text (Goldman & Rakestraw, 2000), which serves to identify the most important information in the new text when little or no topic or domain knowledge may be accessible (Meyer, 1975).

To examine the effects of prior knowledge a researcher can measure this knowledge by either activating readers’ schemata prior to the reading task or measuring the prior knowledge the readers bring to the reading task while reading the related text (Surber & Schroeder, 2003).
However, these two methods may have their own shortcomings. In the case of former, it may not be normal to consider it a well-structured prior knowledge when schemata is built a priory within a short period of time and then put it to experiment (Shapiro, 2004). In the case of later, the weak point is that individual differences (such as language proficiency) may not be controlled for when assessing prior domain knowledge (Surber & Schroeder, 2003). Interestingly, however, the present study tries to focus on the second procedure by examining the effect of already established L1 prior knowledge on L2 reading comprehension. To redress part of the inadequacies associated with this procedure, the researcher controlled the language dimension by administering a language proficiency test. The text difficulty variable as a characteristic of the text itself was also attended to since this may compromise the effect of prior domain-related knowledge on L2 reading comprehension.

2.2. Empirical studies on prior knowledge

A growing number of studies have suggested that prior topic knowledge may substantially affect L2 readers' ability in reading comprehension. For example, Ozuru et al. (2009) examined how text features (i.e. cohesion) and individual differences (i.e. reading skill and prior knowledge) predict biology text comprehension. The results suggested that overall comprehension was positively correlated with participants' prior knowledge.

In a similar study on the effect of prior topic knowledge as well as linguistic simplification on Iranian male students' reading comprehension, Keshavarz, Atai, and Ahmadi (2007) found that prior knowledge had a significant effect, but not the linguistic simplification, on reading comprehension and recall.

In a similar study of monolingual high school students examining the relative contribution of prior topic knowledge and vocabulary, Cromley and Azevedo (2007) suggested that prior topic knowledge in addition to vocabulary had substantially influenced reading comprehension. This can be corroborated by Alderson's (2000) study in which even across passages on the same general theme, which had identical structure and syntax and very similar vocabulary, the more related or familiar version was better understood or recalled.

Clapham (1996) also analyzed the relationship between specific purpose background knowledge and language ability. For this purpose, he studied subjects' performance on field specific and general tests of IELTS and came to promising results. First, students performed higher scores in their subject-matter tests than on the tests outside it. Second, he found that test level of specific purpose background knowledge may have had an effect on their language, and specifically structural knowledge had an influence on the effect of background knowledge on test performance. Third, the more subject specific the text is the better effect of background knowledge on test performance. And finally, it was concluded that if the level of language ability is too high; then, it will compensate for lack of background knowledge.

Surprisingly, however, Hock (1990), attributed comprehension on reading tests to a combination of language and content. She found that comprehension of discipline-related test could be predicted by both knowledge of the subject area and by language level, but that language level was the better predictor.

Peretz and Shoham (1990) stated that topic familiarity and assessed difficulty of a second language text correlated positively with performance on reading comprehension tests in language for specific purposes.

What can be concluded from the studies mentioned so far is that subject matter knowledge or field-specific schemata are very influential in text comprehension. However, the picture is somehow cloudy as to what extent L1 topic knowledge may affect reading comprehension. Surprisingly,
little attention (at least in Iran) has been paid to L1 topic knowledge and its influence on L2 learners’ reading comprehension (e.g. Keshavarz et al., 2007; Ziahosseiny, 2002). As such, the present study, among many factors and variables, tries to attend to this void. Hence, the following research question is posed:

To what extent L1 domain-relevant knowledge predicts L2 reading comprehension across domain-relevant texts?

3. Local context
Before 2010, teacher training centers were active in Iran and had the responsibility to train student teachers for a two-year “Associate of Art” program. All the educational and cultural affairs of these training centers were under the supervision of Ministry of Education (ME). All the applicants with different fields of study (Natural Science, Mathematics and Humanity) were able to sit for student–teacher examinations locally administered by ME. Graduate student teachers were also committed to teach in the local offices of education at the primary and guidance school levels for a course of five years. In 2010–2011 academic year in Iran, high members of ME signed a contract with the Ministry of Science, Research and Technology (MSRT) to boost the professional development of trainee teachers. For this purpose, they established a new institution known as Farhangian University. From that time on, all the applicants for this university (with different background majors in high school) were required to sit for the undergraduate Entrance Exam administered by National Organization for Educational Testing (NOET). The accepted applicants were required to study in a four-year educational program. After graduation, they are required to teach in the Office of Education for about two times the period of their education. One of the established programs in this university is ELT. Student teachers accepted for this discipline should pass all the required courses.

4. Methodology
4.1. Participants
The participants involved in this study (N = 90) were recruited from a population of 270 student teachers (with different majors), studying for an undergraduate course of ELT involved in a four-year teacher-education program in some state universities in Iran. To control the homogeneity of the participants, the researcher administered a proficiency test. Among them, those whose scores were one standard deviation above and below the mean were selected and divided into three different groups based on their secondary school majors (i.e. mathematics, humanity and natural sciences). Their average age was 20 ranging from 18 to 22, with 58 of them being males and 32 being females (SD = 3.22).

4.2. Materials
Two types of materials were used for this study. Primarily a general English course book designed and required for fourth grade high school students was used. This course book consisted of 10 lessons, each including 10 reading comprehension passages. The reading comprehension passages were used as criteria against which the readabilities of unseen passages were calculated (see Table 1).

Two domain-related English course books practiced by students at some private and public universities in Iran were also utilized (see Table 2). They were English for the Students of Sciences (Akhavan & Behgam, 1991) and English for the Students of Humanities (Nowruzi & Birjandi, 1990). The aforementioned course books consisted of 15 lessons, each including 15 reading comprehension passages. Worthy of note is that student teachers of ELT did not practice such course books, but they were used as data source instruments from which three domain-relevant tests each consisting of 30-items were developed to measure ELT students’ ability in reading comprehension across domain-specific passages.
4.3. Procedures for test development and data collection

In order to measure the effect of L1 domain-specific knowledge on student teachers’ L2 reading comprehension across the same domain, first, six unseen passages were selected from two domain-related course books, namely, humanities and sciences. To control the readability indices of such passages, first, the readability indexes of reading comprehension passages included in the general English course book currently practiced by high school centers were calculated and were used as the criteria for estimating the readability of unseen passages. Accordingly, the unseen passages with readability indexes of one standard deviation above and below the mean readability of practiced passages were selected. Based on the unseen passages, three domain-specific tests (each consisting of 30 items) were developed. The tests were different in that they were developed from different subject matter passages but were similar in the type of tasks (multiple-choice, true-false, not given and production ones), and items. In other words, the taxonomy of items and tasks was the same but with different contents. Furthermore, the items were revised based on their wording and content on repeated occasions.

In order to estimate the reliability of the test, the researcher administered the domain-relevant tests to samples of students who were similar to the target groups. For this purpose, the K-R 21 formula was used. The reliability indexes were reported to be 0.72, 0.75, and 0.87 for humanity, natural science, and mathematics tests, respectively. The content validity of the tests was established by experts’ judgment. Based on their comments, the test content and wording were revised. Before administering the validated test to the target groups, it was urgent to ensure the homogeneity of participants (N = 270). For this purpose, a proficiency test was applied. Among them, those whose scores were one standard deviation above and below the mean were selected (N = 270).
Accordingly, they were divided into three different groups in terms of their domains (i.e. mathematics, humanity and natural sciences).

Finally, the three domain-specific tests were administered to the participants in three successive phases, within three weeks. That is, in the first phase, the natural science test was administered to the three groups of participants with three domains of study (natural science, humanity, and mathematics) in one single occasion. And successively, in the second and third phases, the humanity and mathematics tests were administered to the three groups, respectively. Each administration lasted 40 min for the participants. At first, it was intended to administer the three domain-specific tests to the three groups simultaneously in one single occasion. However, to attend to reliability issues, the researcher felt it necessary to consider time intervals for test administration.

4.4. Data analysis
As for data analysis, the statistical measurement of One Way–ANOVA was applied through SPSS (version 20). Finally, to locate the area of difference for each test, the Post hoc Scheffe-test was run.

5. Results
In this study, three groups of student teachers with three different L1 majors (i.e. natural science, humanity, and mathematics) were examined to see whether their L1 domain-specific knowledge influences their reading comprehension ability in the same disciplines across L2 contexts. For this purpose, descriptive statistics and a series of one-way ANOVA followed by a series of Scheffe test was applied across the three groups for each domain-specific test. The results for the three majors are presented below.

5.1. Results for the natural science test
In the first phase of the study, the natural science test was administered to the three different groups. Descriptive statistics on this test (see Table 3) shows that the mean score for the students of natural science was the highest (M = 23.76). This value for the students of humanity and mathematics was found to be 18.66 and 16.93, respectively.

To see whether this difference among the groups was significant, the statistical technique of one-way ANOVA was run for this test (see Table 4). The results from the performance data of the three groups on the natural science test show that the F ratio (7.37) was greater than the critical F (3.11) at .05 level of significance. This result verifies that the performance of the three groups with different majors was significantly different. As for locating the mean differences, a Scheffe test was applied. As illustrated in Table 5, the difference between natural science and humanity...
5.2. Results for the humanity test

In the second phase of the study, the performance of the three group of participants on the humanity test was examined. As displayed in Table 6, the descriptive statistics on this test show that the mean score of the students of humanity is the highest (M = 23.06). That is, students of humanity outperformed the students of natural science (M = 14.56) and mathematics (M = 13.23). To see whether the performance of the three groups was significantly different, the statistical analysis of the one-way ANOVA was applied. The results are displayed in Table 7.

The ANOVA table shows that the F ratio (72.64) exceeded the critical F (3.11) at .05 level of significance. This indicates that the performance of the three groups with different majors was significantly different.

To exactly verify where this difference is located, the Post hoc analysis of the Scheffe test was applied. The results are reported in Table 8.

Table 5. Scheffe test for natural science group

|     | t_{obs} | t_{crit} |
|-----|---------|----------|
| Group 1 vs. 2 | 2.75* |         |
| Group 1 vs. 3 | 3.71* | 2.49     |
| Group 2 vs. 3 | 0.94   |         |

* P < 0.5

Table 6. Descriptive statistics for humanity test

| Students          | N | M    | SD   | Min | Max |
|-------------------|---|------|------|-----|-----|
| Natural Sciences  | 30| 14.56| 4.38 | 10  | 28  |
| Humanities        | 30| 23.06| 2.25 | 17  | 28  |
| Mathematics       | 30| 13.23| 3.31 | 10  | 20  |

(t_{obs} 2.75 exceeded t_{crit} 2.49) groups as well as between natural science and mathematics (t_{obs} 3.71 exceeded t_{crit} 2.49) groups was significant. In other words, group 1 (i.e. natural science) performed better than the other two groups.

Table 7. ANOVA for humanity test

| Source of variation | SS    | DF | MS   | F ratio | F critical |
|---------------------|-------|----|------|---------|------------|
| Between groups      | 1707.22| 2  | 853.61| 2.64*   | 3.11       |
| Within groups       | 1022.66| 87 | 11.75 | P > 0.5 |            |

Table 8. Scheffe test for humanity test

|     | t_{obs} | t_{crit} |
|-----|---------|----------|
| Group 1 vs. 2 | 9.65 * |         |
| Group 1 vs. 3 | 1.51    | 2.49     |
| Group 2 vs. 3 | 11.17 * |         |

* P < .05
In this analysis, the difference between natural science and humanity ($t_{obs}$ 9.65 exceeded $t'_{crit}$ 2.49) groups as well as between humanity and mathematics ($t_{obs}$ 11.17 exceeded $t'_{crit}$ 2.49) was significant. In other words, group 2 (humanity) performed more significantly than the other two groups, indicating that student teachers of ELT perform better on tests which are related to their own field of study.

5.3. Results for the mathematics test
In the last phase of this study, the performance on mathematics test of the three groups was analyzed. The descriptive data observed in Table 9 shows that the mean scores of the three groups were different. The mean score for the students of mathematics was 24.43 which was the highest, and the mean scores for the humanity and natural science groups were 14.96 and 18.36, respectively. To determine whether this difference was significant, the statistical analysis of the one-way ANOVA was used (see Table 10). As Table 10 illustrates, the F ratio (50.91) exceeded the critical F (3.11) at 0.05 level of significance.

The third Post hoc analysis of the Scheffe test was run to locate the significant difference. The results are reported in Table 11. The difference between natural science and mathematics groups ($t_{obs}$ 6.38 exceeded $t'_{crit}$ 2.49) as well as between humanity and mathematics groups ($t_{obs}$ 9.96 exceeded $t'_{crit}$ 2.49) was significant. That is, group 3 (mathematics) significantly performed better than the other two groups.

That is, group 3 (mathematics) performed more significantly than the other two groups, showing that mathematics group performs better on the topics with which they are more familiar.

6. Discussion, conclusion and implications
The present study examined the effect of L1 domain-relevant knowledge on L2 reading comprehension texts among student teachers of ELT with three different L1 majors (i.e. natural science, humanity, and mathematics). The overall results indicated that L1 domain-relevant knowledge is a

### Table 9. Descriptive statistics for mathematics test

| Students           | N  | M    | SD   | Min | Max |
|--------------------|----|------|------|-----|-----|
| Natural Sciences   | 30 | 18.36| 3.93 | 11  | 27  |
| Humanities         | 30 | 14.96| 3.41 | 10  | 20  |
| Mathematics        | 30 | 24.43| 3.69 | 17  | 29  |

### Table 10. One-way ANOVA for mathematics test

| Source of variation | SS  | DF  | MS   | F    | F critical |
|---------------------|-----|-----|------|------|------------|
| Between Groups      | 1379.81 | 2  | 689.90 | 50.91* | 3.11       |
| Within Groups       | 1179.31 | 87 | 13.55 |      |            |

* $P < .05$

### Table 11. Scheffe test for mathematics test

| Group               | $t_{obs}$ | $t'_{crit}$ |
|---------------------|-----------|-------------|
| Group 1 vs. 2       | 109       |             |
| Group 1 vs. 3       | 6.38*     | 2.49        |
| Group 2 vs. 3       | 9.96*     |             |

* $P < .05$
strong predictor of L2 reading comprehension, when language proficiency of participants along with text difficulty was controlled for. Put it another way, this study’s findings suggest that successful performance on L2 reading comprehension questions is strongly determined by the prior L1 knowledge the readers bring with them to the reading task.

Generally, the present findings may be in line with the ones from previous research, though on different contexts (e.g. Cromley & Azevedo, 2007; Guyotte, 1997; Ozuru et al., 2009; Surber & Schroeder, 2003). For example, Guyotte in his study of examining the effect of prior topic knowledge on reading comprehension of three groups of undergraduates (non-medical, pre-medical and medical) across a medical text in a Japanese university found that prior topic knowledge had a significant effect on participants’ ability in reading comprehension. The present study’s findings are also resonant with Clapham (1996) in whose study participants performed significantly higher scores on reading tests in their own subject area than on tests outside it. Based on the findings of this study, several important points are discussed.

First, across the findings of this study, it may be too hazardous to claim that prior-topic knowledge was absolutely effective in predicting reading comprehension ability, though, for example, in the present study language proficiency as one aspect of individual differences along with text difficulty as characteristics of text itself was controlled for. One explanation could lie in the fact that the domain-related texts the L2 readers were exposed to in this study were designed (as introductory course books) for university students. Therefore, they were not highly specific and abstract to include highly complex concepts which may be challenging and at times difficult for readers to ground. This may be the case, especially for science texts included in this study (e.g., biology texts). As Ozuru et al. (2009, p. 239) rightly assert “when reading science texts, readers often do not have a sufficiently developed mental model that represents the overall conceptual relations between the relevant concepts (e.g. relations between hormones and tropism)”. If the L2 texts readers were exposed to in the present study were happened to be challenging with highly abstract concepts like the ones mentioned above, different results could be obtained. For example, natural science group may not outperform the other groups, even across the L2 texts in their own domains. Therefore, further to controlling language and text difficulty variables, level of specificity of domain-related texts should be seriously taken into consideration in future studies.

The second issue at stake needing further explanation in this study is related to humanity passages. Humanity group outperformed the other two groups in this domain. Some of the reading texts were related to history which unlike science texts the reader is assumed to have some general knowledge about the reading text. As Ozuru et al. (2009, p. 239) state “the challenge in reading a social studies or history text is to understand the relations between unfamiliar attributes (specific location, person) of a historic event (e.g. Russian revolution) using general event knowledge (e.g. about revolution)”. With this token, it may happen that all the groups (i.e. natural science, humanity, and mathematics) do not perform significantly different in passages related to history, for example. This makes the picture of interpretation in this phase somehow cloudy. As such, future studies may remove reading texts related to social science, namely history from further investigation when interested in analyzing the effect of L1 domain-related knowledge on L2 reading comprehension. Future researchers also can examine L1 domain-related knowledge across other language skills such as listening speaking and writing.

Findings from the present study may have some implications for material developers and teachers as well. In the present study, it happened that L1 domain-relevant knowledge had a significant effect on L2 reading comprehension. Therefore, the findings of this study would be a starting point for material writers to design and develop English course books in line with student teachers’ L1 major which is related to their immediate life and experience. In this way,
they can promote not only student teachers' motivation but also enhance their quality of learning.

In addition to the above implications for material writers, teachers may also benefit from the findings of this study. Findings from this study may be a good reminder for teachers in that they can benefit from domain-related materials and take them to reading classes so that such materials would become more useful and integral for students. The present findings also highlight that reading instruction is content-centered and prior topic knowledge or schemata activation make reading purposeful.

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