

Curriculum design in practice: Improving the academic reading proficiency of first year university students

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Abstract

This paper describes and reflects on endeavours to develop, design and assess an educational intervention to improve the academic English reading proficiency of first-year university students in Ghana. The study, conducted within the framework of educational design research (EDR), describes the development of an intervention in three different content areas: Literature, Chemistry and Linguistics. The study shows that moving from problem identification to solution is a highly complicated process that is strongly influenced by contextual factors such as staff and student motivation, classroom facilities, and quality of the learning materials. After various cycles of formative evaluation, only the Linguistics course design was fully successful in terms of design, evaluation and experimental set-up and resulted in a significant improvement of students' academic reading proficiency and a significant increase of their time spent on reading for study purposes. The study shows how language skills development can be integrated successfully in content courses in a non-western university context. By doing so, it extends prior research in the area of content-based language instruction.

Keywords: curriculum research; academic literacy; English as a second language, content-based language instruction, reading proficiency.

Resumen

Un diseño curricular en la práctica: La mejora del nivel en lectura académica de los alumnos en su primer año en la universidad

Este artículo describe y reflexiona sobre la tarea de desarrollar, diseñar y evaluar un proyecto educativo para mejorar la competencia de lectura académica en inglés de los alumnos de primer curso de universidad en Ghana. El estudio, realizado en el marco de la investigación de diseño educativo (EDR por sus siglas en inglés), describe el desarrollo de un proyecto en tres áreas de conocimiento diferentes: Literatura, Química y Lingüística. El estudio demuestra que encontrar soluciones para los problemas identificados es un proceso altamente complejo que se está fuertemente influenciado por factores contextuales como la motivación de estudiantes y docentes, las instalaciones en las aulas o la calidad de los materiales docentes. Tras varios ciclos de evaluación formativa, solo el diseño del curso de Lingüística fue totalmente efectivo en términos de diseño, evaluación y desarrollo experimental y produjo una mejora significativa de la competencia en lectura académica de los alumnos y un notable incremento del tiempo dedicado a la lectura para el aprendizaje. El estudio muestra cómo el desarrollo de la destreza lingüística puede integrarse con eficacia en el ámbito de una universidad no occidental. De esta manera, se amplía la investigación sobre el aprendizaje integrado de idioma y contenido.

Palabras clave: investigación curricular, inglés como segunda lengua, instrucción basada en contenidos, alfabetización académica, competencia lectora.

1. Introduction

The increasing demand for the internationalisation of higher education continues to give prominence to English as the language of academic communication in non-native contexts. It has become a strategic linguistic choice not only for marketing universities and other institutions of higher learning, but also for meeting the challenge to produce competitive and efficient graduates for a world where globalisation of knowledge, institutions and professions is on an unprecedented rise (see Coleman, 2006). In ESL contexts, where English is often introduced as early as primary school, one would expect that the use of English for academic communication in higher education would not pose much of a problem. Pre-university institutions, however, have a different culture as well as different practices and values from those of tertiary institutions, and this necessitates planned academic

literacy to enable fresh students to make an effective departure from their tertiary education career (Johns & Swales, 2002; Afful, 2007; Pérez-Llantada, 2011).

While there is paucity of innovation research addressing these issues in developing countries, such as those in West Africa, there is an increasing body of research-based curriculum renewal in Europe (e.g. Pérez-Llantada, 2001, 2011; Shaw & McMillion, 2011; Moore, Ploettner & Deal, 2015), and Asia (e.g. Davison, 2006; Yang, 2015). One approach that has recently garnered interest is content-based language instruction (CBLI), a systematic collaboration between discipline specific teachers and language specialists to design and deliver disciplinary knowledge through English (see Marsh, 2012 and Carrió-Pastor, 2009 for an overview).¹ While studies generally show that this approach helps in developing discipline-specific language proficiency, it has been acknowledged that collaboration across disciplines is challenging and embodies complexities (e.g. Davison, 2006). Motivated by the lack of research that particularly investigates the complexities involved in collaboration, Moore et al. (2015) have recently explored the interaction between a science teacher and a language expert in a collaborative learning project. They identified *inter alia* tensions evolving at disciplinary boundaries, institutional policies and increased workload as some of the challenges.

As a step further, the present study reports on a larger scale research. It describes the processes and challenges involved in the design, implementation, and assessment of a curriculum innovation that integrates content and reading proficiency in a West African context, specifically Ghana. The study is conducted against the background of the quest among Ghanaian universities to prepare first year students to meet the reading demands of university education.

In Ghana, English is the medium of instruction from upper primary (grade four to six) throughout the rest of the curriculum. In the 1980's, however, university educators realised the inadequacy of pre-university language instruction in equipping students for tertiary education. Various universities have since then individually designed a compulsory first year Communicative Skills (CS) subject. Although the content and duration of CS vary across universities, the underlying objective is to improve students' academic communication in English. Our study focuses on two teacher education universities where similar CS subjects are being offered. CS in these universities is a three credit hour subject, spanning two

semesters, and students are required to pass it in order to progress to the second year of their study. While the first semester component focuses on reading and study skills, that of the second semester focuses on writing skills, with each component substantially integrating grammatical knowledge and practice. Tuition is in the form of lectures, supported by textbooks prepared by staff of the English departments and reading exercises are normally based on short passages from periodicals and general literature.

Although the importance of CS in improving students' linguistic competence has been acknowledged by both students and teachers, there are calls to renew the curricula. The main concern is the lack of connection between CS and the linguistic demands of disciplinary specific subjects (Afful, 2007). A recent survey has also pointed to students' dissatisfaction with aspects of the reading component and the need to equip learners with relevant vocabulary (Gborgsong et al., 2015). In addition, the lack of sufficient language teachers results in large class sizes and, in many cases, teachers without language training are recruited as instructors.

As an initial step in addressing this problem, the current study sets out to investigate how the academic literacy skills of students can be improved through a collaborative integration of content and language instruction, with a particular focus on reading. Although CBLI is predominantly associated with European institutions, it has also been used in Asia (e.g. Davison, 2006; Yang, 2015) and South Africa (e.g. Parkinson, 2000; Jacobs, 2007) with success as well as challenges with regards to collaboration. However, while CBLI is predominantly introduced as a new language support curriculum, in the present study, it is used as an innovation in an existing curriculum (see Kennedy, 1988 and White, 1988: Ch. 8 & 9 on innovation).

The participants of the study were B.Ed. students, mostly between 19 - 21 years old. Three subject areas were chosen for the study, namely Literature, Chemistry and English linguistics. The study was guided by the following research question: What are the characteristics of discipline specific teaching and learning activities that could lead to an improvement of English reading proficiency of first-year university students in Ghana? This general question is examined by addressing more specific research questions noted in the following section.

2. Design of the research

The study was conducted within the framework of Educational Design Research (EDR). This approach includes the design, development and evaluation of educational interventions as a solution to particular educational problems. In addition, it yields knowledge about the processes to design and develop interventions and their characteristics (Plomp, 2007). EDR is therefore an approach for investigating the effectiveness of a curriculum or educational innovation (cf. Kennedy, 1988; White, 1988: Ch. 8 & 9).

Six quality criteria proposed by Nieveen (2007) were adopted in systematically identifying the nature of the research problem and designing an intervention to address it. These criteria are relevance, consistency, expected practicality, actual practicality, expected effectiveness, and actual effectiveness. Following Plomp (2007), we operationalised these criteria by organising the study into three phases: a context analysis and problem identification phase (Phase 1), a prototyping phase (Phase 2) and a summative assessment phase (Phase 3) (see Figure 1).

The main objective of the context analysis and problem identification phase was to investigate the following questions:

- RQ1. What are the characteristics of the academic English reading context of first-year B.Ed. students at the two teacher education universities?
- RQ2. Is there a need for an intervention that emphasises improving academic English reading proficiency of first year students at the two teacher education universities? (Relevance)

Three separate lead-in studies were conducted, using both quantitative and qualitative research methods. The results of these studies have been published separately (Stoffelsma & Spooren, 2013; Stoffelsma, forthcoming; Stoffelsma & de Jong, 2015) and they form the basis of the intervention reported in this study (see Section 3.2). A set of tentative design guidelines was formulated for the prototyping phase (Phase 2) based on the results of the lead-in studies (see Appendix I & Section 4.2). Two prototypes were developed as preliminary versions of the teaching and learning activities to improve academic English reading proficiency (see Sections 4.4 & 4.8). The development of prototypes consisted of a number of iterations, each of

which was evaluated formatively. Four research questions were addressed in the prototyping phase:

- RQ3. Is the intervention logically designed? (Consistency)
- RQ4. Is the intervention expected to be usable in first-year courses at the two teacher education universities? (Expected practicality)
- RQ5. Is the intervention usable in first-year courses at the two teacher education universities? (Actual practicality)
- RQ6. Is the intervention expected to result in improved academic English reading proficiency of first-year students at the two teacher education universities? (Expected effectiveness)

The final prototype, the intervention proper, was evaluated in the summative evaluation based on the following question (see Section 5):

- RQ7. Does the intervention result in the desired outcomes? (Actual effectiveness)

We will organise the rest of the paper according to the three phases in which the study unfolds, and conclude it with reflections on issues encountered in the research.

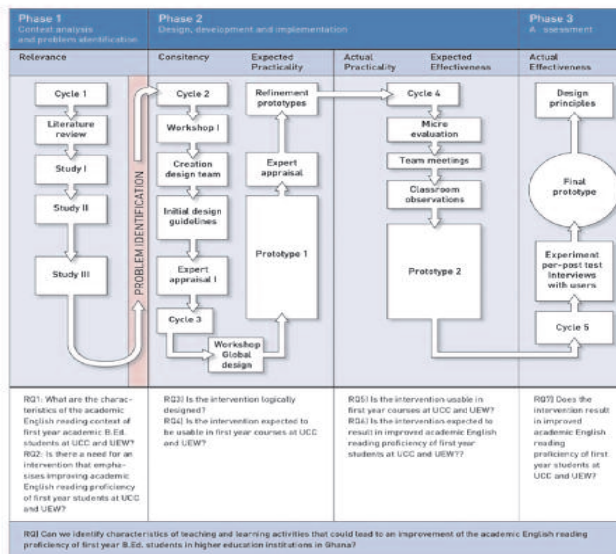


Figure 1. Overall research design (based on Dowse & Howie, 2013).

3. Phase 1: Context analysis and problem identification (RQ1 & RQ2)

This section proceeds to discuss the findings of the context analysis and identifies pertinent problems that are subsequently addressed in the study. The context analysis essentially consists of information gathering. As innovation scholars note, it is necessary to classify information for context analysis under two headings: “*What We Already Know and What We Need to Know*” (White, 1988: 146, original emphasis). We operationalise the first of these two aspects of context analysis in the form of a literature review, supported by our own experience (Section 3.1) and the second in the form of the three lead-in studies (Section 3.2). Context analyses play a crucial role in EDR. Rather than comparing whether, in a certain context, method A is better than method B, design research is aimed at developing an optimal solution for a problem in context (Reeves, 2006). Prior to developing this solution, several studies must inform the researchers about the characteristics of that particular context.

3.1. Outcomes of the literature review

Our literature review shows that the development of Ghanaian students’ linguistic and learning abilities has been influenced by a number of socio-cultural factors. Firstly, the core cultural values in Ghanaian schools promote teacher-centred approaches, content-driven pedagogy and oral responses to teacher’s questions (Heyneman, 2009). At tertiary level, the system of rote learning, verbal recall and memorisation of statements is found to be prevalent in the B.Ed. science and mathematics programmes at teacher education universities (De Feiter, 2006). This culture is not conducive to actively engaging students in independent reading and deeper learning. As noted earlier, the CS subject in these universities, in spite of its benefits, fails to connect reading instruction with the disciplinary needs of students, resulting in students’ inability to appreciate, transfer and consolidate the skills in their long term university studies (Afful, 2007; Gborsong et al., 2015).

The main question addressed in this study is how we can best teach L2 university students in Ghana to become better readers in their disciplines. There is sufficient evidence in the literature to justify the assumption that cognitive strategies and, more crucially for our context, motivation for L2 reading comprehension are learnable and teachable (Grabe, 2009). Building

on prior reviews of reading theory, Grabe (2009) presents a set of instructional implications to strengthen L2 reading comprehension. The following four instructional implications are relevant to this study: emphasize academic and content specific vocabulary, teach text structures, promote extensive reading and develop motivation for reading.

3.2. Cycle 1: Outcomes of studies I, II and III

Based on our lead-in studies, several characteristics of the academic reading context (RQ1) and factors were identified that justified an intervention (RQ2). Lack of space prevents a full description of the outcomes. Only the most important findings are reported.

Study I identified positive correlations between reading behaviour, attitude and self-concept of first-year university students in Ghana (Stoffelsma & Spooren, 2013), which implied that including additional reading activities in the curricula should lead to more positive reading attitudes and self-concepts. Study II is based on a sample of 496 first-year B.Ed. students from the two universities, and showed that 52% of the students manifested a reading ability that was not sufficiently adequate for reading academic expository texts (Stoffelsma & de Jong, 2015). This observation justifies an intervention to improve their reading proficiency. Study III investigated the academic teaching and learning context at the institutions and indicated that Ghanaian students' problems with academic reading skills have been built up in primary and secondary schools, due to a system of "spoon-feeding" and lack of resources and books. Therefore, many students who come in at tertiary level are not trained to be independent learners. This corroborates the observation that the practices of pre-university education are always different from the demands of higher education, thereby justifying the need for transitional support programmes (Johns & Swales, 2002; Pérez-Llantada, 2011). In the Ghanaian context, once students are in university, problems with academic reading are partly maintained because of a number of contextual factors such as lack of textbooks, the use of lecture notes, and large class sizes with few possibilities for individual attention (Stoffelsma, forthcoming). The next section presents the design of a remedial intervention to improve students reading proficiency.

4. Phase 2: Design, development and implementation

4.1. Cycle 2: Workshop I and creation of design team

The communicative approach to educational design research as proposed by Visscher-Voerman and Gustafson (2004) acknowledges the influence of social context on design and is characterised by building relationships with stakeholders to discuss and agree upon the standards and design process and final product (also see Kennedy, 1988; White, 1988: Ch. 9). Working together with users and stakeholders and giving them the opportunity to contribute to the design increases the likelihood that they experience ownership of the product and that it is implemented and used correctly. Onukaogu (2001), for instance, reports on the failure of a language support programme in Nigerian universities due to lack of enough consultation and involvement of teachers in the design of the project. Following Visscher-Voerman and Gustafson (2004), we established a teacher design team for each of the two universities to design and develop the prototypes. A teacher design team can be described as “a group of at least two teachers, from the same or related subjects, working together on a regular basis, with the goal to (re)design and enact (a part of) their common curriculum” (Handelzalts, 2009: 7). A team of five teachers was established for one university and a team of six for the other.² Participation was voluntary. Following the local standards, team members were financially remunerated for their design work. This was considered appropriate since the lecturers were in an administrative system that includes the payment for tasks that are considered “additional” to their normal tasks (see Kennedy, 1988: 337).

Research has shown that the design process and the quality of the design materials are expected to improve when offering support to design teams (Huizinga, Handelzalts, Nieveen & Voogt, 2014). Tailored support was provided in two ways. Specific training sessions were held to train the teachers in curriculum design expertise and pedagogical content knowledge. Furthermore, the design teams were guided on-the-job while designing their courses. A number of international advisors provided feedback during the process. The various design stages are presented in Table 1.

Quality criterion	Development stage	Methods used	Evaluators
Consistency (RQ3)	Design principles	Expert appraisal on initial design principles.	Ghanaian design teams International scholar in curriculum development and design research International scholar in second language acquisition
Consistency and Expected practicality (RQ3, RQ4)	Global design	Interactive 2-day workshop in Ghana with design teams. Decisions on details of intervention: 3 courses selected.	11 academic staff 2 international advisors, and principal investigator
Consistency and Expected practicality (RQ3, RQ4)	Partly detailed intervention	Expert appraisal of first three prototypes. Screening followed by group discussion	International scholar in curriculum development and design research International scholar in second language acquisition International scholar in English linguistics
Actual practicality (RQ5)	Partly detailed intervention	Micro-evaluation of one lecture per institution	Design team, students and principal investigator
Actual practicality and Expected effectiveness (RQ5, RQ6)	Partly detailed intervention	Classroom observation Interviews with staff and students	Design team and principal investigator
Actual effectiveness (RQ7)	Complete intervention (Final prototype)	Experiment: reading proficiency test (pre- and post-test design) Interviews with staff and students	Design team and principal investigator

Table 1. Formative evaluation of design stages.

4.2. Cycle 2: Initial design guidelines

Van den Akker (1999: 5) distinguishes between design principles of a “substantive nature” that refer to the characteristics of the intervention (what the design should look like), and design principles of a “procedural” nature (how the design should be developed). This distinction is well reflected in the format in which Van den Akker (2010) proposes to frame design principles:

If you want to design intervention X [for purpose/function Y in context Z]; then you are best advised to give that intervention the characteristics C1, C2, ..., Cm [substantive emphasis]; and to do that via procedures P1, P2, ..., Pn [methodological emphasis]; because of theoretical arguments T1, T2, ..., Tp; and empirical arguments E1, E2, ..., Eq.

Based on the theoretical [T1, T2, ..., Tp] and empirical arguments [E1, E2, ..., Eq] that were identified in the context analysis and problem identification phase (see Section 3), a set of 14 “tentative” design principles [C1, C2, ..., Cm] was established for the development of a reading intervention programme (see Appendix 1). These tentative design principles functioned as a starting point for the development of the prototypes. Throughout the various research cycles (analysis, design, evaluation and reflection) the prototypes were refined by the design teams. Simultaneously, an inventory was made of the procedural characteristics that best suited the design [P1, P2, ..., Pn]. By the end of the evaluation, a reduced set of “final” design principles remained.

4.3. Cycle 2: Expert appraisal I

Two international advisors and the Ghanaian design teams were invited to participate in the appraisal of the tentative design principles (RQ3) through individual interviews (advisors) and group interviews (design teams). The majority of the design principles were considered appropriate and logical to the reviewers. The Ghanaian design teams were cautious about DP7 (on online reading activities) due to the lack of ICT infrastructure and limited ICT knowledge of staff and students. The international advisors cautioned about reading for enjoyment activities (DP11) within the academic curriculum since this type of reading does not involve academic vocabulary and style. Furthermore, the amount of extra work for DP12 (performing an entry level test) was considered too high. Based on the appraisal, principles 11 and 12 were excluded from the list. Since the feedback on online activities mainly came from one of the two institutions, DP7 was kept on the list.

4.4. Cycle 3: Global design workshop and prototype 1

The global design was specified during a design-team workshop. The results of the context analysis and problem identification were taken as a starting point for the design process. A selection of the courses for the intervention was made by the design teams. The following criteria were used for the identification of suitable courses:

- Course level: the course should be a first-year course, so that students who came in straight from secondary schools would benefit most from the intervention.

- Course material: the course should already include long expository texts in English that students are expected to read.
- Course set-up: there should be a possibility to divide the course into control and experimental groups.
- Target audience: the course should target similar student populations as the samples used in studies I-III (Sciences, Mathematics, Arts and Social Sciences).
- Availability: the course lecturer has to be available and willing to participate in the research.

Based on these criteria, the design teams identified the following courses as suitable and available for the research: Introduction to Literature, Basic General Chemistry, and The Use of English. Over the years, the usual mode of teaching Introduction to Literature and The Use of English had been by lectures only while Basic General Chemistry had been taught through lectures, laboratory experiments and tutorials. Also, students taking Basic General Chemistry comprised B.Ed (Chemistry) and B.Ed (Mathematics) students, each of whom formed one tutorial group.

An experimental set-up was chosen to determine the effect of the intervention. Students were split into experimental and control groups for the course tutorials (1 hour per week with approximately 2 hours of homework per week). For each course, all students participated in the same 2-hour lecture per week and read the same texts. Tutorials were designed to discuss homework and to do activities in class to process the content that was presented during the lectures. The design of the homework and tutorial activities for the experimental groups was guided by the tentative design principles, whereas the control groups followed the course design as used in the previous years. For the purpose of emphasizing students' vocabulary building, the experimental groups were given notebooks for writing down new words. Finally, all students received a hard copy of the homework assignments on a weekly basis (see Stoffelsma & Spooren (2017) for details of the experimental set-up).

The existing descriptions of the courses were used as a starting point for the design. The design principles were used as a framework and translated into student activities. Design tools, such as course templates and evaluation guidelines were provided to the teams (cf. Huizinga et al., 2014). All teams used the same course description format based on the ones already in use at

the institutions: course title, course lecturer, date, target audience, topic of the lecture/tutorial, summary of the lecture/tutorial, learning objectives (knowledge, skills and attitudes, and homework).

In order to make the design phase manageable, the teams decided to choose five tentative design principles as a starting point for the initial design. Based on their personal teaching experiences, they identified the following tentative design principles as most important: DP1 (teaching text structure), DP2 (homework linked to assessment), DP9 (vocabulary training), DP13 (motivate students to read) and DP14 (active learning strategies). These were used as a framework for the drafting of the first course descriptions while the other DP's were integrated in the activities as much as possible. For example, the activity described in Exhibit 1 (signal words) integrates five DPs at the same time: text structure (highlight key words), assessment (presentation of key words during tutorial), large classes (method of group discussions), active learning (presentations of findings during tutorial), and learning new vocabulary (keeping track of these signalling words in a vocabulary notebook).

Design principle	Related homework and tutorial activity
(1) Text structure: signal words	Preview the text and highlight key-words that signal text structure. Discuss the function of these words in groups. Present your key-words and their function during the tutorial. Keep track of these signalling words in your vocabulary notebook.

Exhibit 1. Example of a homework assignment for the Linguistics experimental group.

4.5. Cycle 3: Expert appraisal II

Five weeks after the teams started designing their first course descriptions, an expert appraisal was organised to evaluate the consistency and expected practicality of the first prototypes (RQ3 and RQ4). The purpose of the review was to evaluate the instruction in terms of “intrinsic merits such as content accuracy or technical quality” (Tessmer, 1993: 47). The following question was addressed by the advisors: What is the internal consistency and practicality of the reading activities incorporated in the courses?

The overall feedback from the advisors was positive. They found the activities in line with the rationale of the intervention. They made the following suggestions for change:

1. Add procedural specifications to the course descriptions, in the form of “teacher guides”.

2. Make course activities more in line with each other. Equal time should be spent on vocabulary and strategic reading activities in all tutorials.
3. Diminish the amount of activities. In the current versions there is an overload.
4. Decide up front what kind of vocabulary students would have to learn and design activities accordingly.

4.6. Cycle 3: Refinement of prototypes

The suggestions were discussed and incorporated into new versions of the prototypes. Firstly, the 300 most frequently used academic words from the Nottingham Academic Word List (AWL) were used as a resource for the vocabulary assignments. Selected course texts were screened for AWL words, which were integrated into student assignments. Additionally, the design teams chose the most important content words for each course (Literature, Chemistry and Linguistics). In total, 120 academic and content words were selected per course for the entire semester. An example of a weekly vocabulary assignment is presented in Exhibit 2. In addition, some assignments were included that paid attention to the meaning of words in different contexts.

Vocabulary assignment week 3

The phrases below come from the text by Petrucci. Write down the meaning of the words **in bold** in your vocabulary notebook. Try to use the context to decide on the meaning of the words, if necessary use a dictionary. The words in *italic* (*involved, fundamental, particles, elements, atoms, consist of*) were part of homework week 1 and 2. Revise these words in your vocabulary notebook if you don't remember them.

- The three **subatomic particles** considered in this **section** are the only ones *involved* in the phenomena of interest to us in this **text**. You should be **aware**, however, that a study of **matter** at its most *fundamental* level must consider many additional subatomic particles.
- Each *element* has a name and a **distinctive symbol**.
- This symbolism **indicates** that the *atom* is *element E*, and that it has *atomic Z* and **mass number A**.
- From these **ratios** he **deduced** that about 91% of the *atoms* had one **mass** and that the remaining atoms were about 10% heavier.
- Some *elements*, as they exist in nature, *consist of* just a single type of *atom* and therefore do not have naturally **occurring isotopes**.

Exhibit 2. Example of a vocabulary assignment for the experimental group in Chemistry week 3.

Secondly, a list of specific intended learning outcomes for text structure, vocabulary, and reading motivation was developed per course (see Appendix II and III). The intended learning outcomes were based on Bloom's taxonomy of learning objectives, in which he classified educational objectives into three domains: cognitive (e.g. knowledge, comprehension, analysis, evaluation), affective (attitude) and psychomotor (skills) (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956). The learning outcomes were translated into student activities. One member of the design team with a background in linguistics assisted in the Chemistry course with the development of the homework assignments. As studies show, collaboration between language teachers and content teachers is key for negotiating disciplinary boundaries, in general, and for the success of CBLI (Davison, 2006; Moore et al., 2015). The intended learning outcomes for the control groups were all related to the course subject matters (Literature, Chemistry, and Linguistics).

Thirdly, a student guide was developed with background information on text structures (e.g. paragraphs, topic sentence), skimming, summarising and vocabulary. The 300 most frequently used academic words from the AWL were included in the student guide.

Finally, a weekly teacher guide was developed for each course in which planning of the lectures and reading motivation activities were specifically addressed. The timely distribution of hard-copy materials and sufficient texts among the students formed an important aspect of fostering reading motivation.

4.7. Cycle 4: Micro-evaluation, team meetings and classroom observations

Following the planning of the formative evaluation process, the final course designs were evaluated in three separate steps to assess actual practicality and expected effectiveness (RQ5, RQ6), leading to a second prototype. In practice, the three courses did not follow the same steps of formative evaluation due to logistical and contextual factors. Therefore, the results of the final steps will be presented separately for each course.

4.7.1. Introduction to Literature

Unfortunately, four months after the Literature team started designing their first course description it was decided to stop the intervention. The expected

effectiveness of the complete intervention was rated too low to continue. During the preceding design phases a number of difficulties had been encountered that eventually resulted in this decision. Difficulties included: i) lack of textbooks for students; ii) lack of internet and computer facilities; iii) three female staff members left the project prematurely for study abroad purposes; iv) disappointment of the team with the feedback from the expert appraisal, which they perceived as a failure; v) finally, the work had been more demanding than the team had anticipated.

We can summarise these reasons into three broad issues. The first is the lack of logistics and the pressure on the limited resources of a developing institution. The second relates to conflicts emerging between an “outsider” (i.e. the advisors) introducing an innovation to “insider” faculty (i.e. the design team) who either do not clearly perceive the benefits to be gained by the change or who consider their personal loss to be greater than the gains (Kennedy, 1988: 333). Third, as White (1988) notes, appraisal in innovation projects can be perceived by teachers to be face threatening and often leads to crisis.

4.7.2. Basic General Chemistry

4.7.2.1. Actual practicality (RQ5)

The intervention in practice was faced with a number of challenges. First, dividing the group into equal samples for the control and experimental groups was difficult because of the course schedules of the students (see Stoffelsma & Spooren, (2017), for details). A second challenge was keeping the students from the control and experimental groups apart. At the beginning of the experiment, students from the control group had the tendency to attend the tutorials for the experimental group because they were under the impression that, in the experimental group, concepts were explained in more detail. After the second week, the teacher started using class lists to check attendance to prevent the students from sitting in the wrong group. A third challenge was the marking of the homework. Students in the experimental group wanted to get grades for their homework; however, the tutorial assignments were not integrated into the course grading system. Due to the large number of students enrolled for the entire course (about 1000-1200), students were divided into several groups, which were taught by different teachers. Consequently, it was impossible to adjust the grading system for only the participating group for the sake of the project. Eventually, the students accepted this.

Further, there were logistical issues. The tutorials were held in a Laboratory with an insufficient number of chairs. As a result, some of the students had to stand during the entire tutorial. During the first week, it was difficult for the course representative to distribute the homework to the control and experimental group separately. This problem was solved during the third week.

Finally, the homework assignments for the experimental and control groups were based on the textbook *General Chemistry: Principles and Modern Applications, 9th international edition* (Petrucci, Harwood, Madura & Herring, 2006). Only eight of the students in the experimental group had a copy of the textbook. The others had to work with photocopies or access the book in the departmental library. A complicating factor was that only students from the education department had access to the course book in their departmental library, whereas the core science students did not have this access. In summary, the challenges here comprised the difficulty in altering institutional arrangements (established class groupings and schedules) for an experimental set-up, difficulties with students' collaboration and logistics.

4.7.2.2. Expected effectiveness (RQ6)

Classroom observations and interviews with staff and students revealed three issues that influenced the expected effectiveness of the prototype: the teaching approach and motivation of the teacher, the attitude of the students, and the teaching approach of the other teachers involved in the course.

A few training sessions were organized for the Chemistry teacher with his colleague from the English department on how the reading assignments should be dealt with in class. Observations revealed that, over time, the teacher grew in his role as motivator for students to engage in reading. Also, his capacity of teaching chemistry vocabulary, text structures and engaging students to read improved during the course of the semester. Lesson observations revealed that he used an interactive teaching approach for both the control and experimental groups. He questioned students about the concepts he had introduced, he made them write on the blackboard and he frequently asked if the students had understood what he had said in class. Students generally commented positively on his teaching, especially because he allowed them to ask questions:

Yeah, this one, when we attend this tutorial we have enough time to ask questions. (...) Actually he takes his time to explain those things to us. He is a very good teacher, very good. (CHE, G1/S3)

On the other hand, the Chemistry lecturer experienced great initial resistance from the students in the experimental group. The resistance stopped after the third week of the semester. Students then realised that the assignments helped them to prepare for quizzes and that they performed better than the students from other groups. Interviews revealed that, in the end, students valued the vocabulary and text comprehension assignments. They stated that it helped them in reading and understanding the Chemistry course book and stimulated them to use a dictionary. An important difference between the control and the experimental groups was that the control group stated that they were mostly taught how to solve chemistry problems, whereas the students from the experimental group specifically mentioned that the course had made them more capable of understanding concepts.

4.7.3. The Use of English

4.7.3.1. Actual practicality (RQ5)

The homework assignments for the experimental and control groups from the Linguistics course were based on expository texts from journal articles, textbooks and popular magazines. The amount of time that the groups were expected to spend on homework was equal for all groups.

The design team faced three challenges with regard to the usability of the intervention in practice. Due to the delayed admission of first-year students, some students started late and did not participate in the pre-test. Furthermore, some students from the experimental group had joined the control group on a few occasions. Eventually, a class attendance list was used to address this problem. Finally, in spite of the equal division of tasks on paper, students from the experimental group reported spending more time on their homework than those from the control groups. Thus, while the issue of logistics was not an issue here, there were still problems with institutional arrangements (late admission) and difficulty with student collaboration and the need for negotiation.

4.7.3.2. Expected effectiveness (RQ6)

Two factors influenced the expected effectiveness of the linguistics intervention: the teaching approach of the lecturer, and the attitude and learning capabilities of the students. Firstly, both the micro-evaluation and classroom observations revealed a highly professional performance of the lecturer. She was enthusiastic but critical, demonstrated a positive attitude

towards the students and actively involved them in the course. Many students raised their hands voluntarily to answer questions and also students at the back of the classroom were included in the classroom activities. Most students seemed very well prepared and replied well to the questions. The lecturer checked regularly with the group if they were still following her and she did not hold back in addressing inattentive students. Furthermore, the lecturer explained the concepts clearly and calmly, and made frequent use of the blackboard. She often walked around and gave personal feedback to the students.

Although the team tried to divide the homework equally over both groups, the assignments for the experimental group were more difficult and thus more time consuming. Consequently, classroom observations revealed that the experimental group did not respond as enthusiastically and spontaneously as the control group. This probably has to do with the fact that the experimental group had to work harder and students were more serious. In spite of this, the vocabulary and text comprehension assignments were evaluated positively by all students. During interviews, the students reported to have improved on their vocabulary and language and spelling skills:

... you know, English serves as the basis for the reading of subjects in this institution. So, as we engage in this reading or tutorial assignments and the works that we read, it kind of helps us and also introduces us to new words that we are finding in other courses that we read. (ENG, G4/S2)

4.8. Cycle 4: Prototype 2

The prototypes for both Chemistry and Linguistics were revised on two occasions. The first revision was based on the second expert appraisal (consistency and expected practicality) and had the greatest impact on the design. For all courses, procedural specifications were added in the form of teacher guides and expected learning outcomes were specified in more detail. The number of assignments per week was drastically reduced, which made the design less ambitious and more realistic. The focus of the vocabulary component was structured and based on the AWL and course-specific vocabulary only. Although these modifications changed the design for the better, some team members were disappointed by the fact that some of the work had to be done all over again.

The second round of revision was based on two micro-evaluations, several team meetings during the semester and multiple classroom observations.

This time around, the modifications were less drastic and concentrated more on the refinement of the exercises. For example, some of the assignments for the Linguistics course were rephrased in order to improve students understanding of the questions. Secondly, students were asked to select words themselves for the vocabulary assignments, in addition to working with the pre-set lists of words only. This was done to give room to the students to build their own vocabulary lists and stimulate ownership of their own vocabulary development. Finally, based on the responses in class, it was decided to take a break of 3-4 weeks from the topic sentence in both courses.

5. Phase 3: Assessment (actual effectiveness)

5.1. Cycle 5: Pre- post-test experiment

The actual effectiveness of the complete intervention (RQ7) was evaluated through an experiment, including a reading pre-test and a reading post-test. General findings will be reported here; for a full description of the summative assessment, see Stoffelsma and Spooren (2017). By the end of the intervention, the Linguistics experimental group had improved significantly on their academic reading proficiency ($t(31) = 1.68, p = 0.05$). They had also improved slightly more on their academic reading proficiency than their peers in the control group although the difference between the two groups was only marginal in terms of statistical significance ($t(54) = 1.33, p = 0.09$). The improvement of students' reading proficiency could not be established for the Chemistry students as a stand-alone group. Due to timetable restrictions on the course, it was not possible to equally divide the B.Ed. Mathematics and B.Ed. Science students over the experimental and control groups. Consequently, it was not possible to use the same sampling strategy as was used for "The Use of English". The Chemistry experimental group, therefore, contained only B.Ed. Chemistry students ($n=20$), while the control group contained only B.Ed. Mathematics students ($n=8$), whose number was deemed too low to be an independent group in the analyses.

However, the results show that the time spent on reading in English for study purposes had increased significantly more for the the experimental groups (Chemistry and Linguistics combined) than for the control groups ($t(76) = 1.66, p = 0.05$). This improved academic reading proficiency, however, did not affect the results of the final course exams.

5.2. Cycle 5: Final prototype and design principles

The study started with fourteen tentative design principles (see Appendix 1). During the process of design, development, implementation and assessment, the list of “tentative” design principles evolved into six “final” design principles as follows.

- DP1 (text structures) focused on identifying basic features of text organisation (i.e. headings, sub-headings, paragraphs), identifying topic sentences, summarizing, and explaining different functions of a text. In general, students found these assignments difficult.
- DP2 (assessment) was applied through inspection of the homework and quizzes.
- DP8 (provision of texts) was very much appreciated by the students. This was not common practice in many courses in the curriculum.
- DP9 (vocabulary) was implemented successfully in both courses. Students were actively involved in collecting words for their vocabulary notebooks which were checked in class every week.
- DP13 (teacher as role model) classroom observations clearly showed that teachers motivated students to improve their reading skills through various classroom activities.
- DP14 (active learning) appeared to be one of the most fundamental principles during the intervention. Active learning was supported through timely provision of reading materials and homework assignments, classroom interaction and discussion, and a teaching approach in which students were given responsibility for their own (language) learning

Eight out of fourteen design principles did not make it to the final list, mostly due to practical constraints. No large classes were part of the experiment so DP3 was not relevant in practice. There was no time available for extra tests to monitor progress (DP5), nor to engage students in extensive reading (DP10). Lack of staff time and computers combined with unreliable internet facilities prevented the realisation of DP7. Since pre-selected texts were used, DP6 was discarded. Finally, no specific measures

were taken to prevent cheating (DP4), but the use of small groups and interactive teaching prevented cheating indirectly.

Four factors played an important role in the successful development and implementation of the prototypes. Firstly, the cooperation within the design team was based on the communicative approach (Visscher-Voerman & Gustafson, 2004). A lot of effort was invested in working jointly with design team members and creating ownership of the design (Kennedy, 1988). This allowed for the principal investigator and the design teams to learn from each other during the revisions of the prototypes. Secondly, research has shown that the amount of time that design research requires from its researchers should not be underestimated (Leeman & Wardekker, 2011). If one takes the additional workload for the design teams into account, the financial remuneration of the team members was an important incentive and a necessary condition for the execution of the project (Kennedy, 1988). Thirdly, the integration of language assignments into existing content courses only worked because suitable courses were available that incorporated a sufficient number of expository texts. Finally, the teacher guides provided guidance to the lecturers through procedural specifications.

Returning to the heuristic question posed at the beginning of this study, we can identify characteristics of teaching and learning activities that could lead to an improvement of the academic English reading proficiency of first-year B.Ed. students in higher education institutions in Ghana. Given the theoretical arguments (T1) and empirical arguments (E1) presented in the context analysis studies I-III (see also Stoffelsma & Spooren, 2013; Stoffelsma, forthcoming; Stoffelsma & de Jong, 2015) (cf. Van den Akker, 2010), these characteristics involve the following.

- (i) teach text structures (C1); link homework to assessment (C2); provide a sufficient number of texts (C3); emphasize vocabulary training of academic and content specific words (C4); include teachers who can motivate students to read independently (C5); and use active learning methodologies (C6)
- (ii) the intervention is designed and implemented jointly with a teacher design team via a communicative approach that creates ownership (P1), with sufficient compensation for staff time (P2), via content-based language instruction in already existing courses (P3), and by using exemplary curriculum materials with procedural specifications (P4).

6. Conclusion and reflection

This study set out to solve the problem of first year students' academic reading proficiency and their inability to read independently as a step in proposing a renewal of the CS curriculum. The design, development and evaluation of the intervention passed through a number of iterations, or "micro-cycles of research" (Plomp, 2007: 17). A variety of formative and summative evaluation methods were used to investigate the relationships between theory, design and practice. The study adhered to design-based research methodology, as it went beyond just designing and testing an intervention (cf. Design Based Research Collective, 2003).

In contrast to laboratory studies or experimental studies, design experiments are set in "messy situations" (Collins, Joseph & Bielaczyc, 2004: 20). The current study has shown more than anything that, within the framework of EDR, moving from problem identification to problem solution is a highly complicated process. The process was complex and required endurance of the design teams and principal investigator, just as in any other design research experiment that addresses complex educational problems in real-world or "messy" settings (Collins et al., 2004; McKenney & Reeves, 2012; Plomp, 2013). The successful design and evaluation of an educational intervention depended to a great extent on contextual factors, such as the motivation and quality of the design team, the willingness of the students to participate, and the academic workload of both students and staff. Moreover, logistical factors such as classroom facilities, time schedules, quality of the textbooks, and the internet and printing facilities played an influential role during the intervention. Because of all these influences, each course design followed its own path. By the end of the design, development and implementation phase, only the Linguistics course design had been fully successful in terms of design, evaluation and experimental set-up. In addition, the iterative character of the design resulted in a thoroughly tested solution. Although the Chemistry design succeeded, it was not possible to create conditions for an experimental set-up due to timetable restrictions.

The teachers who took part in the teacher design teams were sensitized to the role of language and literacy in their classrooms. This was particularly the case for the chemistry course. Collaboration between staff from the English and Chemistry departments to jointly prepare educational activities was very innovative in the Ghanaian context. Integrating the teaching of English language into a science course was a challenge that encountered a lot of

resistance. The study demonstrated that science and mathematics students' attitudes toward infusing reading into science could be changed by showing them the benefits of improved scientific literacy.

The fact that each of the three different courses followed a different route in the design, development, and implementation phase clearly shows that each educational context is different from the other. Thus, the present study has produced a number of guidelines, or heuristic statements, which could benefit universities, educators and policy makers in their quest to modify academic literacy programmes, both in Ghana and in the West-African region as well as ESL countries with similar education systems.

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NOTES

¹ Another term that is used for CBLI is ‘Content and Language Integrated Learning (CLIL)’. CLIL has also often been used in a narrow European context in relation to the Bologna Declaration (see Fortanet-Gómez, 2011).

² For the first university, three teachers from the Department of Communication and two from the Department of English Education, and, for the second, four from the Department of English and two from the Department of Chemistry.

Appendix 1

Tentative design principles*

Design Principle	Description
DP1	Aim at improving text structure awareness
DP2	Include homework that is linked to some sort of assessment
DP3	Include teaching and learning activities that are suitable for large classes
DP4	Include measures to prevent students from cheating
DP5	Allow students to monitor their own reading progress
DP6	Allow students to select at least some of the reading material themselves
DP7	Include online reading activities on computers or mobile phones
DP8	Provide a sufficient number of academic texts that are related to the subject content of the courses
DP9	Include vocabulary training
DP10	Include extensive reading of academic texts
DP11	Include extensive reading for enjoyment (story books, magazines, etc.)
DP12	Include an entry level test before students participate in the reading intervention activities
DP13	Include teachers who can serve as role models and who can motivate students to read independently
DP14	Include active learning methodologies, whereby students are engaged in their own reading and learning process

* The order in which the design principles are presented is arbitrary

Appendix 2

Intended learning outcomes regarding text structure, vocabulary, and reading motivation for Basic General Chemistry

Intended learning outcomes	Course week									
	1	2	3	4	5	6	7	8	9	10
At the end of the intervention, students are able to:										
Actively participate in the tutorial and contribute to discussions in class (<i>attitude</i>)	x	x	x	x	x	x	x	x	x	x
Explain why it is important to be proficient in reading academic English (<i>attitude</i>)	x	x	x	x	x	x	x	x	x	x
Identify basic features of text organisation, such as headings, sub-headings, sections, and paragraphs (<i>knowledge</i>)	x	x			x					
Identify the most important sentence of a text (<i>comprehension</i>)	x	x					x		x	
Summarize main concepts introduced in a text (<i>comprehension</i>)	x	x			x					
Interpret the meaning of the author (<i>comprehension</i>)	x									
Analyse text structure, and point out specific text features that emphasize important concepts (<i>analysis</i>)		x	x							
Explain the different functions of a text: informative, persuasive, instructive (<i>comprehension</i>)						x				
Interpret images and figures of a text in relation to the content of a text (<i>comprehension</i>)								x	x	x
Determine the meaning of words based on the context in which they occur (<i>analysis</i>)	x	x	x	x	x	x	x	x	x	x
Consult a dictionary to find the meaning of words that they do not know (<i>comprehension</i>)	x	x	x	x	x	x	x	x	x	x
Explain the meaning of English academic vocabulary and chemistry specific vocabulary (<i>comprehension</i>)	x	x	x	x	x	x	x	x	x	x

Appendix 3

Intended learning outcomes regarding text structure, vocabulary, and reading motivation for The Use of English

Intended learning outcomes	Course week									
	1	2	3	4	5	6	7	8	9	10
At the end of the intervention, students are able to:										
Actively participate in the tutorial and contribute to discussions in class (<i>attitude</i>)	x	x	x	x	x	x	x	x	x	x
Explain why it is important to be proficient in reading academic English (<i>attitude</i>)	x	x	x	x	x	x	x	x	x	x
Summarize short pieces of text (<i>comprehension</i>)	x	x		x				x	x	x
Paraphrase the main ideas in a text using their own words as much as possible (<i>comprehension</i>)				x				x		
Identify basic features of text organisation, such as headings, sub-headings, sections, and paragraphs. (<i>knowledge</i>)		x	x			x				
Evaluate the organisation of a text (<i>evaluation</i>)								x		
Explain how text organisation can facilitate reading comprehension (<i>comprehension</i>)		x	x			x	x			
Predict the content of a text based on skimming the text and by looking at headings, titles, sub-titles (<i>analysis</i>)	x	x		x	x					
Identify the most important sentence of a paragraph, the topic sentence (<i>comprehension</i>)	x	x		x				x		x
Create a diagram to explain relations between concepts (<i>analysis/ skills</i>)			x		x					
Explain references/ citations in academic texts (<i>comprehension</i>)		x								
Identify words that link one section of a text to the following (<i>comprehension</i>)					x					
Point-out sections in the text that explain particular ideas (<i>analysis</i>)							x			
Interpret illustrative diagrams in grammar text books (<i>comprehension</i>)								x		
Explain what <i>micro structural</i> elements of a text are (<i>comprehension</i>)								x		x
Identify the repetition of key words and topic continuity (<i>knowledge</i>)								x		x
Explain the function of linking / connecting words in a sentence or paragraph (<i>comprehension</i>)								x		x
Identify connecting words at sentence and paragraph level (<i>knowledge</i>)										
Explain what is meant by the physical presentation of a text (<i>comprehension</i>)									x	x
Judge the physical presentation of a text (<i>evaluation</i>)									x	x
Determine the meaning of words based on the context in which they occur (<i>analysis</i>)	x	x	x	x	x	x	x	x	x	x
Consult a dictionary to find the meaning of words that they do not know (<i>comprehension</i>)	x	x	x	x	x	x	x	x	x	x
Explain the meaning of English academic vocabulary and linguistic specific vocabulary (<i>comprehension</i>)	x	x	x	x	x	x	x	x	x	x