

A Learner's Technique for understanding Scholarly Articles: An empirical Study

Bee Bee Chua, Danilo Valeros Bernardo
University of Technology, Sydney
Faculty of Engineering and Information Technology
New South Wales, Australia
bbchua@it.uts.edu.au; bernardan@gmail.com

Abstract—Scholars write scholarly articles to introduce new concepts and ideas. Unfortunately, not every learner or reader can understand every scholar's work. One reason for this is that the language used in papers is profound, hence many learners find it difficult to cope with the language and understand the ideas put forward in papers. To overcome this problem, our focus in this research is to develop a teaching-based technique to guide learners toward a better way of understanding and learning from scholarly articles. The technique in this paper is validated in case studies with the support of evidence that shows it is a proof of learning concept which has significantly contributed to guiding students to better practice in their learning. In addition, the use of this technique helps to promote educational sustainability by developing students' interest in appreciating and understanding scholarly articles.

Keywords—scholarly articles; learning technique; education, sustainability.

I. INTRODUCTION

Our recent work [1] demonstrated a practice-based technique to learners. This paper is an extended version which incorporates case studies and compares the results to establish whether the technique can be highly recommended for use.

A scholarly article is defined in many ways. A standard definition describes it as an original research or experimentation written by a researcher or an expert in the field who is often affiliated with a college or university [2]. California State University, Chico [3] conducted a research study to compare and contrast scholarly articles with other article types and established that the language used in scholarly articles is a technical terminology appropriate to the discipline. It is assumed that readers will have a similar scholarly background, but despite this assumption, there is unfortunately no evidence that the process of reading and understanding scholarly articles is easy.

Scholarly articles need to be succinct in order to sustain the reader's interest. Papers are usually circulated within academic institutions and are available to industry because they not only contribute to the body of knowledge, but also to the development of new products and services, new processes and new technology, all of which benefit organizations and society as a whole. They drive innovation and change.

Developing scholarly articles is compelling and challenging. Introducing them in the classroom may

frequently be even more challenging, especially if they are to attract students' interest as a support for their learning.

The reasons are essentially twofold. Firstly, some articles are not easily read and understood due to the technical nature of the language used, and secondly, the students' lack of critical research skills disadvantage them in understanding the methodologies used in the development of the articles.

This paper is structured as follows. Section 2 examines the use of state of the art requirement elicitation techniques to understand scholarly papers. Section 3 contains a discussion of related works on learning approaches, and educators' feedback on scholarly articles is covered in Section 4. Section 5 outlines a new technique which is followed by a discussion of data collection methods in Section 6. Section 7 addresses the issue of understanding subject assessment criteria. Section 8 describes the first case study validation of the technique; in section 9, an overview of results from the case studies is presented. Subsequent case studies are also validated; discussion of their results are in Section 10 and Section 11. Section 12 concludes and updates the direction that research will take in the future.

II. STATE OF THE ART USING REQUIREMENT ELICITATION TECHNIQUES TO UNDERSTAND SCHOLARLY PAPERS

The structure of scholarly papers varies in type and length. Examples of scholarly papers are: 1) research papers, 2) experience reports, 3) short papers, 4) posters, 5) tutorial proposals, 6) tutorials, and 7) panels. A research paper describes original, empirical and theoretical research that is composed of new techniques and tools. Usually, a full-length research paper comprises about eight pages. Some full research papers consist of new interpretations, while others require in-depth case studies for analytical findings.

The three largest groups of people who frequently need to access, retrieve and read scholarly papers are educators, researchers, and students. They read scholarly papers to: 1) conduct new research, 2) collect information, 3) advance knowledge, and 4) collect ideas and translate them into projects.

Although scholarly papers are documents to be read for the importance of their information content, they should also be thought of as undoubtedly significant learning drivers for students, teaching them how to think, reflect and review their knowledge.

To encourage learners to read and understand scholarly articles, some common requirement elicitation techniques from the field of software requirements [4] are widely introduced to group-learners and an individual-learner. Examples of requirement gathering techniques include brainstorming, prototyping, interviews and agile methodology [4] [5] [6] [7] [8] [9]. All have been developed and used to clarify, elicit and confirm requirement needs with users. Such techniques are thought to be worth introducing into the academic environment to promote learning effects by encouraging socialization and interaction between learners. These techniques are useful for group discussion and for promoting group synergy, with its potentially positive effects on student learning.

According to Ambler [5], agile methodology highlights story telling from an unclear scenario. It is effective for eliciting users' or customers' requirements, and is useful for helping users to clarify their knowledge through an implicit method, by putting their ideas into a narrative to help the developer understand their requirements. However, it does not promote a critical review of suggestions or ideas.

As information technology rapidly advances, the availability of learning tools has become increasingly sophisticated. Learning tools [11] [12] provide adequate features and functionality to facilitate better learning. According to Chua et al. [13], these tools support learning activities but cannot replace current strategies or introduce new learning strategies or practices.

Integrating scholarly papers into any learning activity can facilitate the learning process effectively and can stimulate learning by providing interest and excitement. A number of traditional teaching and learning methods fail to explicitly demonstrate how to introduce research into practice-based learning.

Many learning methods focus on theory-based and practical-based components, but very few have integrated research-based components into their learning processes. Few researchers could imagine how the mapping of scholarly papers enables learners to improve their learning performance and even to experience joy in reading them.

III. RELATED WORKS ON LEARNING TECHNIQUES

The term 'learning' is broad. Buchanan and Huczynski [14] define learning as 'the process of acquiring knowledge through experience which leads to a change in behaviour'. In other words, learning is not just the acquisition of knowledge, but its application by doing something different in the world.

A familiar scenario that has incorporated changes can drive us to learn something new, or adjust to a new way of operating, or to unlearn something. From an organizational learning [15] point of view, learning is associated with two

important concepts: the first is the power of knowledge acquisition, and the second is the power of knowledge sharing. Understanding scholarly articles provides readers with knowledge and thus increases their ability to knowledge-share with others [16] [17].

It is therefore important to encourage students to learn through reading scholarly articles. However, integrating these articles in the classroom remains a challenging task for educators.

Acknowledging that this is an issue that impacts learning in the classroom, the focus of this paper is to introduce a learning technique that can assist educators to integrate scholarly articles and case-based learning in their teaching.

Case based learning is not a new concept in education. It is effective, but can be challenging. These challenges have been discussed widely in research that focuses on achieving better learning experiences by recognizing the depth of the subject content while increasing the capacity of the learner to develop skills, including problem solving skills [18] [19] [20] [21].

Case based learning can be conducted either by individuals or by groups. Traditionally, the method involves face-to-face teaching. Although some researchers claim that face-to-face teaching of case based reasoning is one of the most traditional and effective learning methods, it demonstrates a lack of learning innovation. Face-to-face teaching is usually conducted in a classroom environment where one or more learners absorb the concepts or theories directly from an educator. The learner can clarify immediate doubts directly with the educator.

This method promotes a dual learning loop: questions from learners and feedback from educators. The drawback of this approach is that not all learners are able to accept and adapt to an educator's teaching techniques. In particular, the technique used in case based reasoning does not promote student learning through the sharing of ideas and knowledge among individuals in the class. Hence, some students find learning difficult, rather than enjoyable or fun. In the worst case, students can become bored with a single and lengthy case study, and instead of their learning horizons being widened, their thinking narrows to focus solely on the case.

IV. EDUCATORS FEEDBACK ON SCHOLARLY ARTICLES

We surveyed educators to understand what their aims were for learners who have read scholarly papers. Every educator has different expectations and requirements; for example, some educators provide scholarly articles for learners to read, but their requirement is for learners to summarize the article in their own words. This means writing a short version of the research paper from which the educator can assess the learner's writing and analytical skills.

The process is similar to the 'requirements elicitation' technique.

Some educators, however, do not ask for a summary page but want to know how the learners judge the scholarly articles; in other words, they want to test their evaluative skills. This process is similar to the requirement gathering technique called 'prototyping'.

Some educators want learners to answer questions in response to scholarly articles. The aim is to test their critical analysis in problem solving, and this process is similar to the interview technique. Some educators want learners to discuss what the article is about, a process which is similar to the agile methodology of story-telling. One commonality of these approaches for scholarly papers is managing and eliciting requirements.

V. A NEW TECHNIQUE

Our objective in introducing the new technique is to provide learners with a better way of understanding scholarly articles by a combination of processes (eliciting, analyzing, clarifying, reviewing, verifying and validating) so that they can get the most out of papers which can provide them with valuable knowledge.

The inward process of the technique emphasizes how learners' skills (communication, analytical and team skills) can be strengthened, and the outward process of this technique is a knowledge sharing mechanism for others. In addition, this technique can help to strengthen learners' skills by making them: 1) responsible for interaction, 2) accountable for critical review, and 3) empowered to produce innovative ideas and decision making. The diagram in Figure 1 illustrates each process.

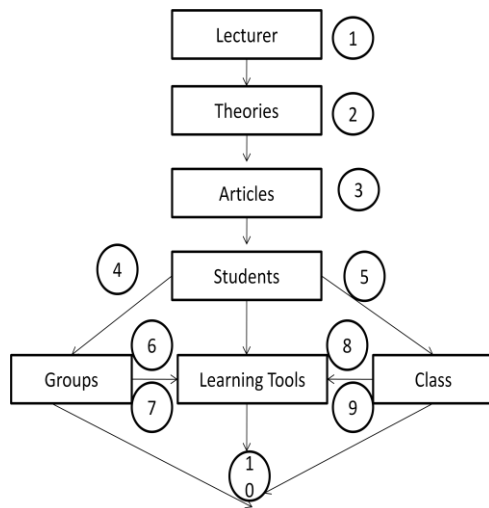


Figure 1. The framework for a practice-based technique on scholarly papers

The steps below show how each individual task is processed.

1. Delivery by lecturers

Theories are delivered by lecturers to the class.

2. Imparting knowledge of theories to the class

Students learn these theories from the lecturer, and their ability to understand concepts is assessed by giving them scholarly articles that relate to the theories discussed in class.

3. Introducing scholarly articles to students

Selected articles are distributed to students.

4. Communicating and sharing of information by students with the aid of the learning tool

This tool supports and facilitates discussion on the paper's topic.

5. Class contributing their answers on the learning tool

All students in the class take part in the discussion using the learning tool.

6. Group problem solving

Students in each group perform brainstorming sessions to understand the article and decide the questions to be asked in class for class comments and suggestions.

7. Uploading questions and answers on the learning tool

Individual groups upload either open-ended or closed-ended questions in the forum of a learning tool to address problems, concerns and challenging issues discussed in the paper.

8. Class participation

The class reads the papers and provides answers based on the questions asked by the group, either quantitatively or qualitatively. Students are also encouraged put related questions to the group.

9. Individual student participation

Individual students must answer the questions discussed in the forum.

10. Group presentation

Students present their findings in class.

The presentation covers: 1) understanding the paper's content, 2) addressing problems and concerns about the paper, 3) discussing questions and answers posted on the forum, 4) consolidating findings in a summary format, and 5) proposing a strategy, if necessary in relation to the questions asked by other students in the class. Feedback is provided by the class and the lecturer.

Current designs of learning and teaching techniques [11] [12] [13] are useful, especially for widening the range of teaching materials that can be easily understood by students

and that will encourage them to engage in deep learning rather than surface learning. Nonetheless, they lack the ability to elaborate interactively on the students' learning, and no significant evidence was found in the literature review to demonstrate that these techniques provide good support for students in learning scholarly articles effectively.

VI. DATA COLLECTION METHOD

Concern as to how the technique will be validated and the number of case studies needed for such validation is, no doubt, a crucial issue. A framework is proposed to validate the technique in classes and observe step by step how the process works on educators and students. The steps below outline the sequence of the data collection process:

1. Scholarly articles selected by educators.
2. Formation of groups to be decided by educators.
3. Each group is asked to select a scholarly paper.
4. Each group is asked to read and analyse the paper, and then to highlight an important concern that has not been discussed in the paper.
5. Each group is required to upload questions and ask the class for their participation on the learning tool.
6. Each group must summarise class members' feedback on questions and present their discussions and/or answers in class.
7. In a particular week, an anonymous survey will be distributed to students to comment on the technique.
8. Students return the survey to the subject coordinator for data analysis and data interpretation.
9. Three results are revealed. The first result presents an overall statistical rating on closed-ended questions; the second presents comments made by students on questions posted on the forum; and the third result offers qualitative analysis based on the open-ended questions.

VII. SUBJECT ASSESSMENT CRITERIA

Students are informed of the marking criteria in this subject. Figure 2 shows the subject assessment criteria for understanding scholarly articles. Students were asked to rank their priorities in understanding scholarly articles. Of the three assessment criteria, seven groups gave the component of research skill the highest mark on innovation and invention (see Figure 3).

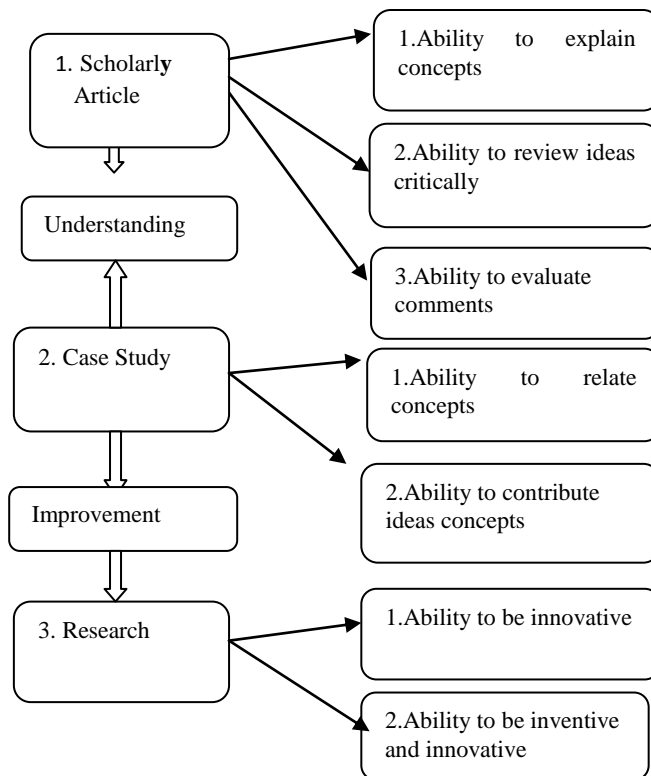


Figure 2. Subject Assessment Criteria

They must have realized that without a good understanding of scholarly papers, it is very unlikely that they would be able to incorporate the research ideas into their discussions on a learning tool

Goal Prioritization by Group	Class A					Class B				
Group	1	2	3	4	5	1	2	3	4	5
Scholarly article Structure	1	2	2	3	2	1	3	2	2	3
Case Study	2	3	3	2	3	3	2	3	3	1
Research Skill	3	1	1	1	1	2	1	1	1	2

Figure 3. Goal Prioritization by Group

VIII. TECHNIQUE VALIDATED IN FIRST CASE STUDY

One author of this paper is a subject coordinator who coordinates a post-graduate subject offered to information technology students. A past survey result showed high and good ratings for the teaching, but not for the subject.

In order to validate our proposed technique, we selected a postgraduate subject having two classes, A and B, as the main focus of the case study and as part of the unit analysis. We carried out an experiment on fifty students from both classes in five weeks and, according to what we observed, data was analyzed from surveys and information that was

posted by students on an online discussion board using an e-learning tool.

Past feedback from many students expressed concern at the difficulty in understanding scholarly articles. Many could not interpret what the authors discussed in the paper. As a result, students did not like the subject or the support materials handed out by the subject coordinator. Rather than re-design the whole subject, the coordinator analyzed all aspects of the learning factors that impacted on the students' learning, and reviewed all processes, including tools and techniques. The learning environment was the first area to be evaluated to discover whether there were any missing or inappropriate resource supports for the students.

The learning tool that was provided to the students provided good functionality and adequate features, according to our observation, and was therefore not believed to be the cause of the problem. As such, the tool was retained. Next, the coordinator reviewed ten different scholarly articles, carefully selected by us, to determine whether they were difficult for students. This review confirmed that there was no replacement of the existing articles, as that was not primary teaching goal. The teaching goal was to encourage students toward deep learning, rather than surface learning and the objective was not, therefore, to change the ten papers being used. Instead, the coordinator revisited the presentation structure, as a result of which it was recognized that it was necessary to re-engineer the presentation process so that the subject matter would be explicitly clear to students, both informatively and intuitively. It was decided to outline any missing steps between the old and new presentation structures, in order to achieve improvement in the subject.

Our objective is to ensure that students are more engaged in their learning and hence we proposed the development of a collaborative interface between students at group and class levels for questions and discussions. This interface acted as a two-way communication process that made groups responsible for posting their designed questions, and the class responsible for feedback on the designed questions.

Fifty students from two classes in one semester took part in the new process. Ten scholarly articles were chosen, on topics ranging from understanding Michael Porter's framework on the five forces to strategic information planning. Papers published by ACM, MISQ and IEEE were the focus. Students listened attentively to the settings for the paper discussion in the first lesson. Each group was made up of five students. Ten groups of five students per group were formed, and each group was given a different paper topic to read, analyze and discuss.

Of the concerns raised, some students were confused about the actual process because it was the first time they had experienced such a technique. A minority of students felt insecure and lacking in confidence because detailed data had to be collected and interpreted in one of the steps, and they had no prior knowledge of research skills.

There were no negative responses from students about the learning process, but acceptance of change was not readily forthcoming when the new technique was introduced.

IX. RESULTS FROM THE FIRST CASE STUDY

The first week of presentations by the two classes went well. Students knew what to do for each paper. They had to: 1) identify a problem issue discussed in the paper (a process equivalent to requirements gathering), 2) contribute their opinions or comments on the paper (a process equivalent to requirements elicitation), 3) ask the class for feedback on questions they asked (a process equivalent to requirements clarification), 4) respond to comments from their classmates (a process equivalent to requirements review), 5) know how to summarize their findings and propose a strategy (a process equivalent to that of requirements changes), and 6) present their data or findings in a class presentation (a process equivalent to requirements traceability).

The presentation structure, the learning tool and the interface for group discussion are the events on which we sought understanding. Students claimed that class A's papers were more difficult than class B's papers. The statistics report showed that class A received more responses than class B, even though the papers were difficult.

We believe that class A students received a high response rate due to the fact that the topic interested them, and thus they focused on that, rather than on the paper's difficulty. The same group of students had to analyze data (feedback) from the class and summarize their findings in one presentation slide. Two of the five questions had to involve a critical review of the research into technology and an analysis of the data collected from their classmates. They were also required to propose ideas for solutions to a particular problem based on their classmates' feedback.

In other words, they had to be able to think of a strategic approach and show why it was useful, thought provoking, innovative and interesting. Most importantly, they were asked to summarize findings from the five questions and to conduct an oral presentation to the class the following week in order to leverage knowledge and knowledge transfer of the topic, ideas and solutions for the class.

TABLE I. Class A and B data with students' responses to the paper

	Class A (16/20)					Class B (25/30)				
Paper	1	2	3	4	5	1	2	3	4	5
Difficulty	*	*	-	-	*	-	-	*	*	*

Paper	8	15	6	5	24	13	7	8	6	11
Length										
Responses	8	3	2	2	1	4	3	9	4	5

by our students that scholarly papers were too hard to read. We think this is the same belief that drove a similar situation in software development, in which the team always found it difficult to understand some of the users' requirements because they were vague or incomplete. In fact, a well developed process to help developers understand requirements simplifies the situation and makes users' requirements understandable.

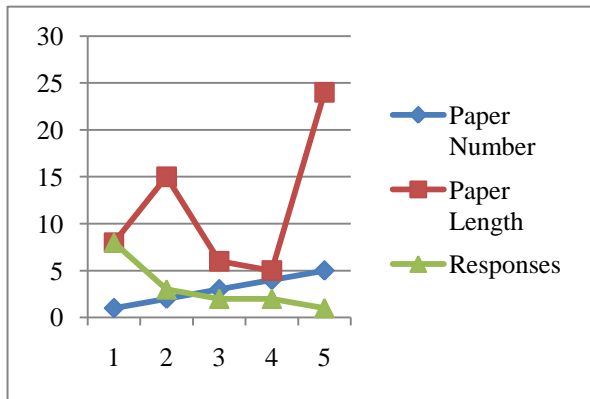


Figure 3. Class A Data with students' response to the paper.

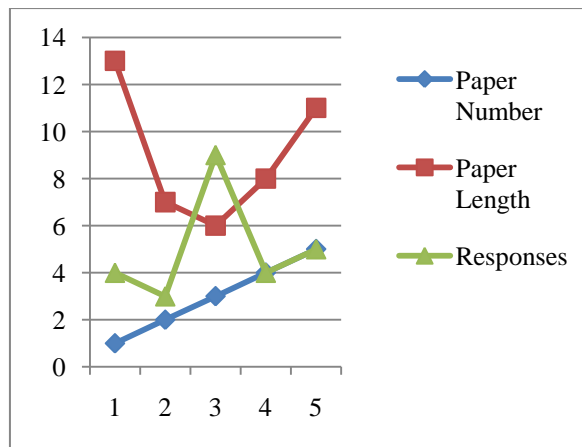


Figure 4. Class B data with students' responses to the paper.

After week five, an anonymous survey was distributed to all students to evaluate their responses to the technique. Forty-one out of fifty students completed and returned the survey. Nine students did not complete it as they did not attend the class. The survey findings are shown in Table 1, Figure 3 and 4.

Difficult papers were rated with an asterisk, indicating that students had difficulty reading them and understanding the scope, and that they had to read them more than once. Before we reviewed the learning process, we were convinced

This learning technique underpins the process for assisting students to overcome the barrier of reading difficult papers. The aim is to make them realize that academic papers are not complicated or hard to understand. It is a guiding process on the 'how' and 'what' of reading scholarly articles.

We were also keen to know whether students liked the presentation structure. The process for the presentation was to have them read an article, post designed questions and then analyze data from the class feedback and comments from the subject coordinator for an oral presentation. In this question, we were able to gain many valuable insights from students' responses. Most of their comments are similar and we summarized them into four aspects: 1) article topics, 2) paper discussion, 3) questions posted on the forum, and 4) their oral presentation. We were pleased to find that feedback from the students was positive. For the article topics, the words used repeatedly are:

'Topics are current significant, clear and interesting', 'good knowledge', 'It sharpened our thinking', 'Topics are thought-provoking', 'They give us business aspects of a technical field', 'They broadened our knowledge of IT strategies'.

The comments on the paper discussion showed that students felt it was *'informative'*, and that *'team dynamics were unique'*. They agreed that the process involved two-way discussion and they *'enjoyed it'*. They also believed that such discussion helped them *'not only get to know each other better but also able to share their experience and knowledge within the group level and class level'*. On the questions posted on the forum, one student commented that *'questions are a good help to think critically and relate to the paper and real life experiences'*. As for the oral presentation, many students claimed that the purpose was to *'help understand the topic well', 'stimulate discussion in class and feedback from the subject coordinator'*.

Students commented that *'there was a lot of information'* and *'argumentative and critical evaluation'*. They felt that they learned how to *'build oral communication skills, negotiation skills and analytical skills, as well'*.

As a supplementary question, we wanted to know whether students found the presentation structure helpful to their learning; for example, whether it led to better understanding of the scholarly articles. 98% of students agreed that the presentation structure did help them to understand the scholarly papers better. One student offered a comment that was not negative about the presentation

structure, but rather concerned the length of the paper. He felt that some articles were slightly longer than others and thus took longer to read.

Another student believed that some students' answers in the forum discussion showed a lack of clarity – either their answers were incomplete or the meaning was not clear – and it would have been better if they had provided resource links to justify their findings clearly from journals or books.

X. TECHNIQUE VALIDATED IN SECOND CASE STUDY AND ITS OUTCOME

One semester later, the same technique was validated in the same subject. The total number of students enrolled was fifty and each group had ten students. They were given scholarly articles to read and told to use the framework in Figure 1 to assist their understanding. At the end of the teaching semester, students were asked to complete a survey designed by the subject coordinator. Students' responses in the result findings (see Table 2 and Figure 5) are similar to those of the first case study.

TABLE II . Class C data with students' responses to the paper.

Class					
Paper	1	2	3	4	5
Difficulty	*	*	*	*	*
Paper Length	7	8	15	10	11
Responses	9	10	8	10	10

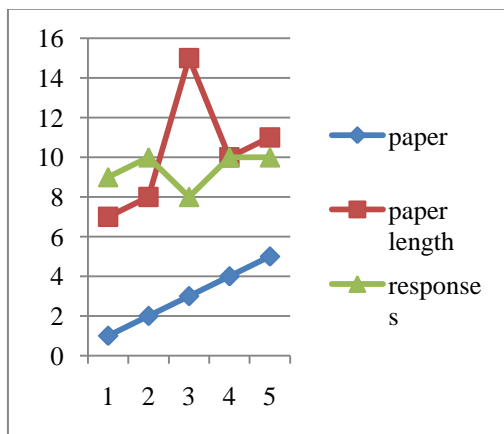


Figure 5. Class C data with students responses to the paper.

Some constructive comments were made in this semester, particularly in relation to the questions posted on the forum, and their oral presentation. Two students commented that the questions posted on the forum by groups analyzed them quantitatively, which did not provide useful insights to the paper topic. Ideally, it would be helpful for groups to provide in depth answers.

XI. TECHNIQUE VALIDATED IN THIRD CASE STUDY AND ITS OUTCOME

It is highly recommended that the technique should be cross validated in different subjects in order to evaluate its results. In another faculty, a research-based subject with heavy emphasis on scholarly articles did not receive a good subject rating, hence the subject coordinator wanted to seek subject improvement. He agreed to use the technique for a trial period during one semester to see whether this would help to improve his subject rating level. He was interested to discover whether the length of scholarly articles affected students' ability to read and understand.

In total, 20 students were enrolled in the subject (Class D). Although the enrolment was not large, the number of students seemed sufficient for us to analyze the results, as long as they were new students learning how to read and understand scholarly articles for the first time.

Fifteen students took part and completed surveys. The information in the returned surveys enabled us to explicitly investigate whether there was any validity threat to the technique. Not to our surprise, the students' feedback was similar to that of students in the first subject. The following Table 3 and Figure 6 illustrate the Class D data.

TABLE III . Class D data with students' responses to the paper.

Class C (15/20)					
Paper	1	2	3	4	5
Difficulty	*	-	*	-	*
Paper Length	9	15	7	6	14
Responses	3	2	5	2	3

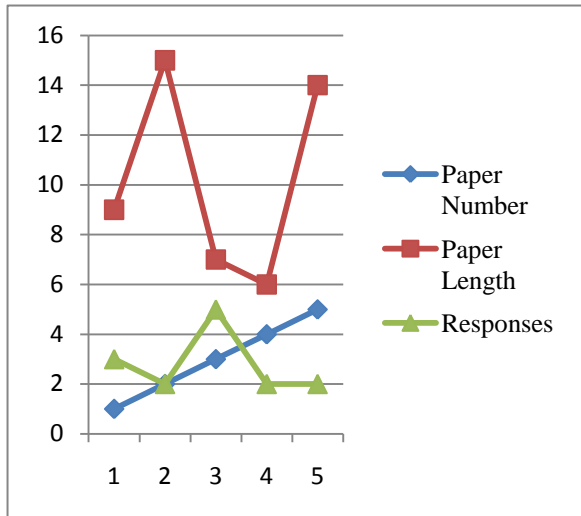


Figure 6. Class D data with students responses to the paper

The results shown in this table and diagram clearly identified to the subject coordinator that there is no significant evidence that students' difficulty in understanding scholarly articles is due to the length of the paper. Three students mention that papers 1, 3 and 5 are difficult despite their length and size. Paper 1 has 9 pages, paper 3 has 7 pages and paper 5 has 14 pages. The most highly rated by students is paper 3. Five students feel that it is difficult.

In the survey, we asked students to comment on the usefulness of the presentation structure. Fifteen students agreed that the process of presentation really helped them to better learn the concepts and theories discussed in the papers. One student commented that the presentation can be time-consuming but is nevertheless thought-provoking.

In order to establish the technique's reliability and effectiveness, it must be validated in more than one case study. The more case studies involved in the validation, the more accurate and reliable the technique can be considered to be.

XII. CONCLUSION AND FUTURE WORKS

Existing case studies reveal that the technique can be applied effectively in research-based and coursework-based subjects in which students might be experiencing difficulty in understanding scholarly articles. The technique appears to be convincing enough to be suitable for use in small classes.

Strategies discussed in this paper are twofold. The first strategy was to observe the technique introduced into the subject and to see the effect on students and their ability to accept difficult scholarly papers. The second strategy was to conduct a survey to measure student satisfaction with the technique.

From the survey, we see that the technique is successful, in particular from the positive comments showing that many students like the technique, and from the relationship between the questions and answers.

Two research strategies were proposed in case studies [22] in order to review the technique to ensure that it is practical and sustainable. We were not simply looking for techniques to assist students to overcome their learning problems; we were also concerned that our technique could be easily used and adapted by educators anytime, anywhere and for any subject.

Our future research study will seek to validate this technique in large classes and in programming subjects, to establish whether it is suitable to use in such contexts. Many concerns remain to be addressed: for example, is this technique able to support a large class of, say, 600 students? Is a learning tool a necessary aid for supporting resources and setting up a forum discussion? What are the limitations of this technique? These questions will roll into the next phase of our research investigation, which will be more in-depth and analytical.

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