Developing Research Questions: A method for transforming a question into a problem statement

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***Abstract*— In this research to practice paper, the results of an approach for transforming topic ideas into questions for developing a research problem statement are presented. The purpose of this study is to assess students' understanding of the research problem they pose to address. The goal is to motivate students to think beyond their own interests in the topic and consider the interests of a broader audience. An Activity Worksheet Method for transforming questions to a problem statement was developed. The worksheet asks students to articulate if the problem they plan to address is a practical or a conceptual problem. In this paper we present results from undergraduates who used the activity worksheet method to transform questions to a research problem statement. The main research question is "How do students perceive the usability of the Activity Worksheet Method for developing problem statements?" The activity worksheet was completed by 41 students enrolled in two sections of an undergraduate data visualization course in the Department of Computer Graphics Technology at Purdue University. After completing the worksheet, students were asked to provide feedback on the usability of the worksheet. Results show 68% of students responded positively when questioned on the usability of the worksheet. The responses were based on a 5-point Liker scale ranging from 1-5: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4) and Strongly Agree (5). The implications of this work will help students build skills in developing strong research questions that inform a practice that is required in engineering and computing education. The contribution of this work is in helping students to pose questions and ask questions that will strengthen their critical thinking skills in the practice of engineering and computer science.**

Keywords*— *students' perception, problem statement, research questions, constructivism, critical thinking, higher order thinking, activity worksheet

I. Introduction

The purpose of this study is to assess students' perception of a worksheet method designed to help students articulate their understanding of the significance of the research problem they pose to address. The goal is to motivate students to think beyond their own interests and consider interests of a broader audience. An activity worksheet was developed to help facilitate critical thinking among students about their topics. The first aim of the study is to introduce an Activity Worksheet Method for transforming questions to a problem statement for developing research questions. The second aim is to assess students' perception of the usability of the Activity Worksheet Method in identifying practical and conceptual aspects of the research question. In this paper we present results from undergraduates who used the Activity Worksheet Method. The main research question is "How do students perceive the usability of the activity worksheet for developing problem statements?" Elements of cognitive constructivism and critical thinking are used in the worksheet to help students think about and articulate undesirable consequences that might result if the research is not done. The implications of this work will help students build skills in developing strong research questions that inform a practice that is required in engineering and computing education. The contribution of this work is in helping students to pose questions and ask questions that will strengthen their critical thinking skills in the practice of engineering and computer science. We present a method that incorporates cognitive constructivism learning theory, critical thinking and intelligent behaviors of habits of the mind into the process of developing a problem statement for research questions.

II. Background

A. Cognitive Constructivism

Cognitivism deals with a person's cognitive abilities and mental processes of an individual when completing an intellectual task [1]. Piaget, a well-known cognitivist scientist, poses that knowledge is constructed when a student is encountered with a cognitive conflict [2]. Piaget identified two processes in cognitive development, namely assimilation and accommodation that are two sides of adaptation to learning [3]. Assimilation is the process of incorporating new knowledge into existing knowledge; it is the basic underlying structure of any learning [2] process. An example of assimilation is illustrated in this work in the case of a student who is new to learning the research process, specifically developing a problem statement for further research. In learning how to do research, students will refer to knowledge they have gained during their academic studies, for example, writing a report that details the outcomes of the scientific method or engineering design process [4]. In writing the report, the student uses knowledge of the series of steps involved to implement the process to find answers to address the problem they attempt to solve. The scientific method and engineering design process consist of a series of steps that

guide the processes to solutions. Both processes are iteratively refined, enabling learning to occur at each stage. In the context of this study, although the process of developing a well-defined problem statement might be new to students, students' prior knowledge gained from implementing the scientific method or engineering design process will help in identifying the significance of problem and possible actions to be taken towards a solution. Accommodation, on the other hand, is the process of amending existing cognitive knowledge and structure; it is associated with using the same learning approaches into multiple ways. For example, in this study, when a student who is familiar with steps involved with implementing the scientific method or engineering design process is asked to think specifically about a problem from practical and conceptual perspectives, as opposed to being given a problem with a predetermined outcome solve, the student will need to add new information to their existing knowledge base. We assume all students have taken a basic science course before matriculating to college.

Constructivism, as a learning and meaning making theory, focuses on the construction of knowledge and meaning by individuals [5]. "The central principles of [constructivism are] that learners can only make sense of new situations in terms of their existing understanding. Learning involves an active process in which learners construct meaning by linking new ideas with their existing knowledge" [6]. Constructivism is a theory of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world [7]. There are several guiding principles of constructivism [8]:

1) Learning is a search for meaning.
2) Meaning requires understanding wholes as well as parts.
3) In order to teach well, we must understand the mental models that students use to perceive the world and the assumptions they make to support those models.
4) The purpose of learning is for an individual to construct his or her own meaning

Three manifestations of cognitivist constructivism that are directly applicable to this study include the modification of students' existing knowledge structure [2], learning as a search for meaning (understanding wholes as well as parts), and reflective thinking [9]. By working through the activity worksheet, students identify the significance of a topic and develop a problem statement to support research to address the problem. The intent of the worksheet is to guide students through a process of examining what they know and do not know about a topic - what action students want the reader to take, and what the reader should think about the solution the student proposes. An important aspect of this process is identifying the significance of the topic from multiple perspectives [10]: the students' perspective and from the readers' point of view. In the context of this work, learning starts with the topic students choose for their research. The learning process focuses on understanding the problem from different perspectives (practical and conceptual) in an attempt to help students develop a holistic view of their topic. Learning is constructive when an active role is played by the learner [2]. Reflective thinking, as a cognitivist learning strategy, can be used in a wide variety of teaching environments including, but not limited to, lecture halls, small group sessions or simulated environments [9]. In the context of the Activity Worksheet Method, an example of reflection *in* action would be to ask students to articulate the situation or condition they desire to address in their research and why it is important to them. An example of reflection *on* action would be to ask students to describe the undesirable consequences caused by that condition and articulate what can be done about it. These tasks are captured in the Questions to a Problem Activity Worksheet.

B. Implications for Engineering and Computer Science

In our work, critical thinking, higher order thinking and information literacy are utilized in the identification of re- search topics as a mechanism for developing and refining of transferable skills that will serve students throughout their educational and professional experiences. Thinking and communicating with clarity and precision, striving for accurate communication in both written and oral forms [11] are the higher order thinking skills and intelligent behaviors fostered by the Activity Worksheet Method. The work of [11] provides several useful guides for educators to reflect on how to develop habits of mind and intelligent behaviors that are especially valued for a given course or task. The habit of mind most relevant to this work, is the habit of "Questioning and Problem Posing." Answers and solutions to Questioning and Problem- Posing will drive the subsequent research process. In a study that examined the role of problem discovery in the creative process, Runco and Okuda [12] found that students generated significantly more responses to discovered problems (where they had to define a task as well as to suggest solutions) than to present problems (where they needed only to suggest solutions to already defined tasks). The authors concluded that students should be given the autonomy to discover their own problems and solve them [13]. In this study the focus is on developing a problem statement to support further research and building students' confidence for eventual self-directed development of research problem statements.

Constructivism has influenced educational thinking about curriculum and instruction; it underlines the emphasis on the integrated curriculum in which students study a topic from different perspectives [14]. Literature shows pedagogical theories and frameworks utilized in this work are represented in engineering [15] and computer science [6] curriculums.

At the center of research is information. Information literacy is essential to engineering [16] and computer science and has been shown to be a successful in integrating data science into computer and information literacy courses [17]. Critical thinking and higher order thinking are hallmarks of engineering [18] and computer science. Within the field of computer science education, the constructivist approach can take many forms that result in students building skills and confidence [19]. In the context of this work, students are guided through the process of thinking critically about the intended impact of their work by constructing statements to help students understand what they

want the reader "to do" and help students understand what they want the reader "to think" regarding the proposed research.

> The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experiential skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advances," [20]

This element of constructivism aligns with the current study in the sense that students are asked to consider practical and conceptual perspectives of their research topic. Engineering tasks, discoveries and solutions are driven by problem statements. It is imperative that students can not only generate solutions but also understand various perspectives that inform and drive the problem they attempt to solve. A practical problem, as described by [10] (pp 50 -51), is caused by some condition that troubles us because it costs us time, money, respect, security, opportunity, even our lives; we solve a practical problem by doing something or by encouraging others to do something to eliminate or at least mitigate the condition creating these tangible costs. Students are used to focusing on their own interests and are rarely asked to consider who their audience is and what actions their audience should/could take in response to research outcomes. Examples of practical computer and engineering problems include: optimization, failure and stress analysis, and system reliability. Although STEM related examples are provided, practical problems are not limited to STEM fields.

The Activity Worksheet Method, introduced in this work, is adaptable. The developed worksheet provides a discipline agnostic approach for facilitating question-asking and problem-posing among students. In research, a conceptual problem arises when we do not understand something about the world as well as we would like to understand it [10]. Conceptual problems are often addressed by the development of frameworks and models that support decisions made during the implementation of a process. Examples of conceptual frameworks vary depending on context. Conceptual models are plentiful across all disciplines. Frameworks and models can be easily located with a thoughtful scholastic web search.

Literature shows pedagogical theories and frameworks utilized in this work are represented in engineering and computer science curriculums. For example, a constructivist learning environment was the basis for supporting question-based learning for first year engineering students to learn design data flow diagrams (DFD) [15]. The purpose of the research detailed by [15] was to provide effective support for notices to learn how to create data flow diagrams regardless of their programming experience. The approach utilized a constructivist learning environment to scaffold students' involvement in the process of knowledge construction. When introducing new material, scaffolding provides a temporary framework to support learning and student performance beyond the learners' capabilities [21] (pp. 235). Cognitive load theory [22] states novices have limited working memory for dealing with new information concurrently. To address this issue, Hu and colleagues [15] devised "analysis tables" and a process to implement the tables as scaffolding to guide students in developing data flow diagrams from data tables. Students were given a small excerpt of a system description and were asked to answer several thought provoking questions about the system. Answers to the questions inform how a DFD maps from the analysis tables. The scaffolding approach for teaching first-year students DFDs mirrors the approach utilized in this work. In our study the activity worksheet serves as a catalyst for scaffolding the problem statement development task in four steps.

Step 1: Students identify a topic of interest, and provide a description of the topic using a required sentence format. The structured format provides a narrow focus for the articulation of why the student is interested in the topic and what their readers should understand about the topic. Step 2: Students are asked questions about their topic that require them to consider different perspectives (practical versus conceptual) of the topic. Step 3: Students are asked to identify which perspective best describes their interest in the topic. Step 4: Students are asked to articulate the significance of the topic. Students complete the first step to articulate their understanding about their topic.

When students move from step 1 to step 2, students begin to think beyond their current knowledge of the topic and consider possible consequences of their work. When they move from step two to step three, students consider which perspective (practical or conceptual) aligns with their interests. Moving from step three to step four require students to focus on why the topic is significant, which, fosters the use of critical think- ing skills. Critical thinking is the ability to solve a problem, pose questions to the solutions and develop arguments with a sound basis in the underlying theory [18]; these elements are hallmarks of engineering and computer science.

The constructivist approach can take many forms that result in students building skills, confidence [19] and self-efficacy in their ability to think critically. A few examples of how these skills fit into wider programs include: generating research questions through problematization [23], developing thesis and dissertation research questions [24], and developing research questions through grant proposal development [25]. The work presented in this paper provides an additional lens through which students are guided through a process of thinking critically about the potential impact of their work.

III. Questions to a Problem Worksheet

The "Questions to a Problem" worksheet is designed to guide students through the process of transforming questions associated with research topics into a sound problem statement. Describing how to create an effective problem statement can be the germ of an informative lecture, but remains ineffective unless students are given the opportunity to practice this skill [25].

The worksheet consists of four parts. The first part asks students to generate one succinct sentence detailing the significance of their topic. The sentence should explain the

topic, the question they plan to answer and why the topic is important. The structure of the sentence is adopted from [10] and provided in the worksheet:

A. Identify the significance of your topic by completing the following sentences:

a) The topic I am studying is X
b) because I want to find out Y
c) in order to help my reader understand Z.

In the constructed sentence, X is the description of the topic, Y is what the student identifies about the topic that is to be studied, and Z is significance of the project. The second part asks student to determine if the identified problem is a practical or conceptual problem.

B. Determine if the problem is a practical or a conceptual problem

Once the topic sentence is complete, students are introduced to the concepts of practical and conceptual problems and guided through the process of determining which concept most accurately characterizes their research problem. For most students, who have never done research before, the concepts of practical and conceptual problems are a new way of thinking about problems. Students are given three questions, that if answered, will help them to determine if the problem identified in the first question is a practical or a conceptual problem.

a) What's the situation or condition you desire to address, and why is it important?
b) What's the undesirable consequences caused by that condition including costs that you (or your readers) do not want to pay? Why is it important?
c) What do we do about it?

We acknowledge research problems and statements are discipline specific and the approach to developing problem statements is driven by the focus of the research. Finding the significance of a problem is hard [25], even for experienced researchers [14]; however, it is important that students understand the significance of identifying the practical implications of their research. A practical problem motivates the research question which defines the research problem; the research problem leads to a research answer to help solve the practical problem [10].

C. Practical or Conceptual?

After answering questions a-c, students are asked complete one the following questions to further help in determining if their problem is a practical or conceptual problem:

- Practical Problem: What action do you want your reader to take?
- Conceptual Problem: What should the reader understand about the topic?

In the context of this work if the student's desired outcome is for some action to be taken by the reader, then they are asked to describe a practical problem. Conversely, if the students' desired outcome is that the reader has a better understanding of the topic, then the problem is considered a conceptual problem. Answering the questions will help students to have a better understanding of the problem they intend to solve with their research.

D. Problem Statement

Ideally, thoughtful completion of the previous sections, in their entirety, will enable students to connect the dots between identifying a topic, transforming a topic to questions, utilizing those questions to identify the significance to the topic to inform a sound research problem statement. In this part of the worksheet, students are asked to explain, based on the information they have generated and their knowledge about the topic, why the reader should care about the topic. The Questions to a Problem worksheet is provided in Appendix A.

IV. Methodology

A. Participants

The research was implemented in an introductory data visualization course at Purdue University in Fall 2019. The 16-week course met twice a week with a lecture/lab format. The learning objective for the course is to introduce the data visualization process. Upon completing the course, students are required to demonstrate their proficiency in applying the data visualization process by presenting results from a research topic of their choosing with data and visualizations to support their conclusions.

The "Question to a Problem" worksheet was completed by students enrolled in two sections of the course. Section A consisted of undergraduates majoring in STEM related fields. Section B included students participating in a campus-wide data mine data visualization (DMDV) living learning com- munity. Students in Section B were a combination of STEM and non-STEM majors. A total of 41 students completed the worksheet: 20 students from Section A, and 21 students from Section B. Table I shows participant academic levels for each section. Seventy-six percent of all participants were sophomores.

TABLE I. PARTICIPANT CHARACTERISTICS

Academic Status	**Combined Sections %(Count)**	**Section A %(Count)**	**Section B %(Count)**
	(n=41)	***(n=20)***	***(n=21)***
Freshman	2%(1)	0%(0)	5%(1)
Sophomore	76%(31)	70%(14)	81%(17)
Junior	17%(7)	25%(5)	10%(2)
Senior	5%(2)	5%1	5%(1)

B. Data Collection

Data for the study consists of the completed "Question to a Problem" worksheet, and students' self-assessment for the usability of the worksheet. Students were given the worksheet in week three of the semester and given one week to complete and submit the worksheet for review by the professor and

teaching assistants. After completing the worksheet students were asked to provide feedback on their perception of the usability of the worksheet using a 5-point Likert scale: 1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, and 5-Strongly Agree. Students used the Likert scale to indicate their level of agreement, to three statements:

- The worksheet helped me identify my topic as a practical or conceptual problem.
- The worksheet helped me understand what I want the reader TO DO after viewing the project deliverables.
- The worksheet helped me understand what I want the reader TO THINK after viewing the project deliverables

If students indicated strongly disagree or disagree, they were asked to provide a brief explanation. Students' qualitative feedback will inform evaluation and refinement of the worksheet for future class offerings. Analysis of students' qualitative responses is not covered in this article.

C. Data Analysis

Data analysis aligns with the second aim of the study: to assess students' perception of the usability of the Activity Worksheet Method in helping to identify students' research topics as practical or conceptual problem. For this work, only student self-assessment data for the usability of the worksheet are analyzed. Data analysis of Likert scale data was performed. The mean is used as the basic indicator of statistical outcomes. T-test calculations are used to compare Likert scores by sections and by questions. Microsoft T.TEST function was used to calculate p-value using two-tailed distribution, for two- sample unequal variance. An alpha level of .05 was used for all tests to determine statistical significance.

V. RESULTS AND DISCUSSION

The main research question addressed by this work is: "How do students perceive the usability of the activity worksheet method for developing problem statements?" To answer this question, we examined Likert responses for the assessment feedback and Likert responses for each individual statement on the assessment feedback instrument.

A. Overall Assessment of Usability

Likert scales were used to capture students' perception of the usability of the worksheet. To assess students' responses to the worksheet as a whole, all responses to each of the three statements from the self-assessment feedback instrument were combined. A total of 122 responses were analyzed: 59 responses from Section A and 63 responses from Section B. One student from Section A did not provide a response for statement three resulting in different participant sizes for analysis where responses for all statements are considered and in the analysis of individual statements. The mean is used as a statistical indicator of students' perception. For this work, a mean value greater than three is considered favorable, corresponding to agree or strongly agree. A mean value less than three is considered unfavorable, corresponding to disagree or strongly disagree on the Likert scale.

The overall mean for the worksheet is 3.7 (Table II), indicating, overall, students' perception of the usability of the worksheet is positive. Table II also so shows a p-value of 0.05 was calculated for the overall mean score for the worksheet. A p-value less than or equal to 0.05 is considered statistically significant (indicated by * in Table II). The p-value indicates there is a 94% chance the difference between the two sections A and B is not due to random variation. The calculated p-value for the worksheet suggests the difference seen is statistically significant. So, given Section B has a higher mean value (3.9 versus 3.6) there is sufficient evidence to support further study of the differences between the two sections (STEM majors in Section A and a combination of STEM and non-STEM majors in Section B).

TABLE II. T-TEST RESULTS FOR COMPARISON BETWEEN SECTIONS

Mean			t-Test
Overall (n=122)	***Section A (n=59)***	***Section B (n=63)***	***p-value***
3.7	3.6	3.9	0.05*

We examined the combined frequency responses for each statement (S1, S2, and S3). The mean responses overall and for each section ranged from 3.6 to 3.9 (Table II), indicating "neutral" on the Likert scale of response options. Closer examination of frequency responses shows there were no "strongly disagree" responses, and a few "strongly agree" responses from both sections. The most frequent response overall, and for each section was "agree." Fig. 1 shows approximately sixty percent of responses from Section B were "agree" compared to approximately fifty percent of responses from Section A. Students from Section A had a higher number of neutral responses compared to Section B.

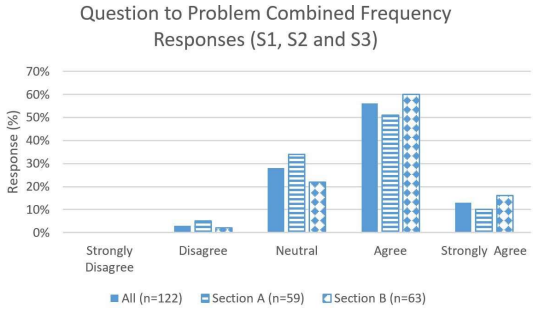

Fig. 1. Combined Frequency Responses for S1, S2, and S3.

B. Assessment of Usability Statements

In this section we examine mean values and t-test results for each usability statement. The mean values for the combined responses from both sections, for each statement were 3.6, and 3.9 for S1, S2 and S3 respectively. The overall mean values indicate, on average, both sections responded positively to each of the following statements:

1) Statement 1 (S1): The worksheet helped me identify my topic as a practical or conceptual problem.

2) Statement 2 (S2): The worksheet helped me understand what I want the reader TO DO after viewing project deliverables.

3) Statement 3 (S3): The worksheet helped me understand what the reader should THINK about the project after viewing project deliverables.

Table III shows, of the three statements, statement one had a p-value of 0.02*, which suggests the differences between the students' responses for statement between sections is statistically significant. The statistical significance suggest the differences between the two sections are not due to random variation between the two sections. We anticipated similar findings for statements two and three; however, Table III shows p-values for S2 and S3 are greater than the threshold for statistical significance.

TABLE III. T-TEST RESULTS FOR USABILITY STATEMENTS BY SECTION

Usability	**Mean**		**t-test**
Statement	***Section A***	***Section B***	***p-value***
S1	3.4	3.9	0.02*
S2	3.7	3.8	0.61
S3	3.8	3.9	0.63

Since the t-test suggests significant differences between the sections, for S1, the frequency responses were examined for each section. Fig. 2 and Fig. 3 show combined frequency responses for each statement (S1, S2, and S3) for Section A and Section B, respectively. The solid vertical bars represent S1, vertical bars with horizontal lines represent S2 and the vertical bar with the fill pattern represents S3. Section A responded most favorably to S3, indicating Section A found the worksheet most helpful in understanding what the student wanted their reader "TO THINK" about the research topic. Section B responded most favorably to S1 and S2, indicating Section B found the worksheet most helpful in identifying topics as practical or conceptual, and helpful in understanding what the reader should/could "DO" after viewing project deliverables. Graphical results are consistent with p-value results for the overall worksheet (discussed above).

C. Limitations

We are encouraged by the favorable mean values for each of the statements; however, we notice, as seen in Fig. 2 and Fig. 3, students in Section A tended to give more "neutral" responses. For most students the idea of thinking of their topic as a practical versus a conceptual problem might be new concepts to process. The specifics of a neutral response are unclear. There is no indication as to if students did not know, were indifferent or just randomly selected a neutral response.

We realize, after analyzing responses, a response scale with 1 to 5 points tend to consistently average a value of 3 making it impossible to accurately understand respondents' real assessment. An even-numbered scale will be used in future implementations of the worksheet to ensure the point 3 more accurately associate with either negative or positive opinion.

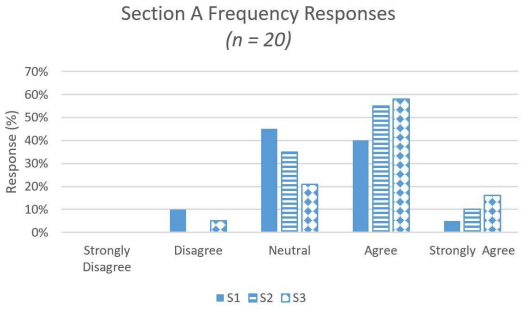

Fig. 2. Combined Frequency Responses for Section A.

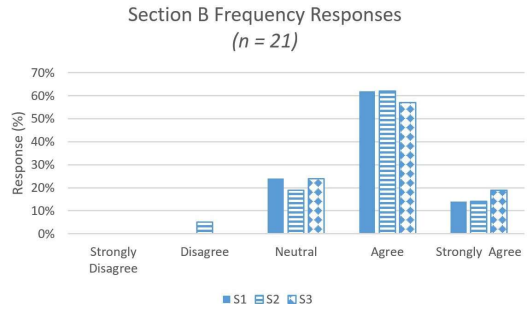

Fig. 3. Combined Frequency Responses for Section B.

Statements 2 and 3 on the self-assessment survey correspond to questions two and three on the activity worksheet. Both statements and questions ask students to determine if their topic is a practical or conceptual problem then articulate what action should be taken by the reader. This element of the worksheet engages a critical/higher order thinking principle related to implications and consequences. Paul and Elder [26] states, "to reason well through an issue, you must think through implications that follow from your reasoning; you must think through the consequences likely to follow from decisions you make." The worksheet is intended to motivate students to think about the consequences and implications of their topics and potential outcomes. In hindsight, we see another limitation of the process, perhaps more scaffolding is needed to ensure students understand the concepts and the expected outcomes.

The goal of the worksheet is to train students to generate their own effective and relevant critical-thinking questions. One way this is done is by providing students with the structure and guidance of exemplar examples [27]. The worksheet provides some basic structure for guiding critical thinking; however, more could be done to provide more examples to strengthen the worksheet as a stand-a-lone instrument.

Future implementations will also consider self-questioning by students, to generate their own questions with some guidance on specific aspects to consider, for example, evaluation and provision of evidence, comparison and contrasting practical and conceptual aspects of the topic.

Students are asked to provide feedback if their reply is "strongly disagree" or "disagree," in future offerings of the worksheet students will be given the option to provide feedback for each response, in an effort to capture a more accurate account

of what a "neutral" response might represent. Incremental implementation of the study will include a qualitative analysis of the worksheet that includes a comparison of students' understanding of their self-identified research problem before and after using the worksheet and evaluation of how well students developed their critical thinking skills because of the worksheet activity. Further work is needed to examine the level of understanding students have regarding determining what needs to be done to address a practical and/or conceptual problem. Overall, this work shows students found the worksheet to be helpful identifying their topic as a practical or conceptual problem.

VI. CONCLUSION

Despite the small sample size and limitations detailed above, important insights about the Activity Worksheet Method for transforming a question into a research problem statement has been presented. Our study provided an approach to help students develop and exercise critical thinking skills and to think about the implications and consequences of their decisions. The results show students' perception of the method is positive and we are encouraged by the statistically significant findings for the worksheet overall and for statement one which suggests the worksheet helped students to identify their topic as apractical or conceptual problem. The data suggests students are not completely confident in determining what they want the reader to do versus what they thing the reader should think about the topic. Further refinement of the worksheet is needed to consolidate the present findings with larger samples from students at various stages of the academic process (for example graduate students), to assess the usability of the worksheets on different domains of knowledge and thinking skills [28]. In this study, only the usability of the worksheet was examined. Future studies will examine the worksheet as a data artifact along with students' perception of the worksheet. If completed in earnest and in it's entirety, the worksheet becomes a valuable resource for the next stage of the research process: identifying appropriate data sources to support subsequent research.

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APPENDIX A

From Questions to a Problem Worksheet

Goals: To identify the significance of a research topic and generate a research problem statement to drive the subsequent research plan.

Objective: Students will transition from a broad topic to a specific question.

Outcomes: Students will answer the Who/what/when/where/whether/why and how questions about their topic.

1) Identify the significance of your topic by completing the following sentences
   a) Topic: The topic I am studying is
   b) Question: because I want to find out what/why/how
   c) Significance: in order to help my reader understand.

   Your completed sentence should read:

   The topic I am studying is fill in this blank with your text, because I want to find out fill in this blank with your text, in order to help my reader understand fill in this blank with your text.

2) Use the space below to determine if your problem is a practical or a conceptual problem by answering the following questions about your topic.

   a) What's the situation or condition you desire to address, and why is it important?
   b) What's the undesirable consequences caused by that condition including costs that you (or your readers) do not want to pay? Why is it important?
   c) What do we do about it?
   a) Practical vs. Conceptual Problems: complete one of the two questions about your problem
      i) Practical problem: what action do you want your reader to take?
      ii) Conceptual problem: what should the reader think?

3) Significance
   a) Explain why you want your reader to know and care about the topic.

Resource: Booth, W. C., G. G., Williams, J. M., Williams, J. M. (2003). The Craft of Research. University of Chicago Press (Chapter 4).

APPENDIX B

Self-Assessment Usability Instrument

Using the Likert scale below, indicate your level of agreement to the following statements:

S1. The worksheet helped me to identify the topic as a practical or conceptual problem.

Strongly Disagree [], Disagree [], Neutral [], Agree [], Strongly Agree []

If you answered Strongly Disagree or Disagree, please provide a brief explanation.

S2. The worksheet helped me to understand what I want the reader TO DO after viewing the project deliverables.

Strongly Disagree [], Disagree [], Neutral [], Agree [], Strongly Agree []

If you answered Strongly Disagree or Disagree, please provide a brief explanation.

S3. The worksheet helped me to understand what I want the readers TO THINK about the topic after viewing the project deliverables.

Strongly Disagree [], Disagree [], Neutral [], Agree [], Strongly Agree []

If you answered Strongly Disagree or Disagree, please provide a brief explanation.