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## **MIXED METHOD ANALYSIS IN ASSESSING THE EFFECTIVENESS OF INTENTIONAL LEARNING INSTRUMENTS IN TEACHING CIRCUITS**

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### **Abstract**

*Research results on Intentional Learning proved positive implications in the teaching and learning processes. In this study, the researcher analyzed data gathered from the implementation of Intentional Learning Questionnaire in Electric Circuit (ILQ-EC) and Intentional Learning Module (ILM) as the intentional learning instruments. The over-all study involves implementation of ILQ-EC, development of ILM and testing its effectiveness using quantitative and qualitative research analysis. Previous research used ILQ-EC in identifying motivation and learning strategies factors which were highly correlated and predictive to conceptual understanding of student respondents. These factors served as the benchmark in the development and testing of ILM for this present study. Results for both quantitative and qualitative analysis showed that high gainers tend to be more intentional, specifically, more critical thinker and with higher perceived competence than low gainers. Moreover, average normal gains of the student-participants after using ILM was higher compared to previous research results using different learning approaches. ILM evaluation based on student responses*

also confirmed the influence of ILM in their learning gains. Thus, enhancing intentionality proved significant effect in the teaching and learning process.

## Keywords

Intentional Learning Instruments, Mixed Method, Circuits, Learning Gains, Module, Pedagogy

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## 1. Introduction

Research on Intentional Learning has been conducted and specific factors affecting learning were determined (Bucayong & Ong, 2018). Specifically, these factors were *perceived competence* and *critical thinking*. The initial conduct of the said study focused on the development of intentional learning questionnaire in electric circuit (ILQ-EC). This ILQ-EC instrument is different from existing electric circuit (EC) tests since the construct was not designed for the assessment of learning but to measure the motivational factors that the students were engaged in and their preferred learning strategies in understanding direct current (DC) electric circuits. The learners were given the chance to select and apply their preferred strategies which, according to Tabone (2009), this intentional learning approach may empower the learners for best result. Student's learning strategy is his or her style of learning as well as acquiring and eventually using information. The learner's preferred approaches enable him to understand facts and solve problems (Montalvo & Torres, 2004).

However, the study conducted by Tan & Balasico (2018) identified different predictor variables to the students' academic performance. The most predictive among others is the learners' mathematical ability. Other studies have shown that students practical work matters in students learning (Lee & Sulaiman, 2018) and the specific starting line affects the students' academic performance (Sek, et.al., 2018). In this vein that the present study seeks to verify if the identified intentional learning factors using the Intentional Learning approach (Bucayong, 2016) have truly substantial bearing on the conceptual understanding of the students in the context of electric circuits. Modular type of instruction was performed using Intentional Learning Module (ILM). This ILM was developed basing on the identified intentionality factors, which means, *perceived competence* and *critical thinking* factors were enhanced in the approach and in the content of the module. In other words, teaching and learning approaches in the module were focused on how to heighten the student's critical evaluation of the concepts and his/her confidence to perform the related tasks.

Testing of the identified intentionality factors involves implementation of ILM as an intervention in the teaching and learning process. Quasi-experimental in a pretest-posttest design was conducted for the quantitative analysis. Following interview protocol, respondents for qualitative research part were taken from the upper and lower 20% basing pretest and posttest results. Result of this study may be used for the furtherance of other related researches regarding teaching and learning in physics and others sciences.

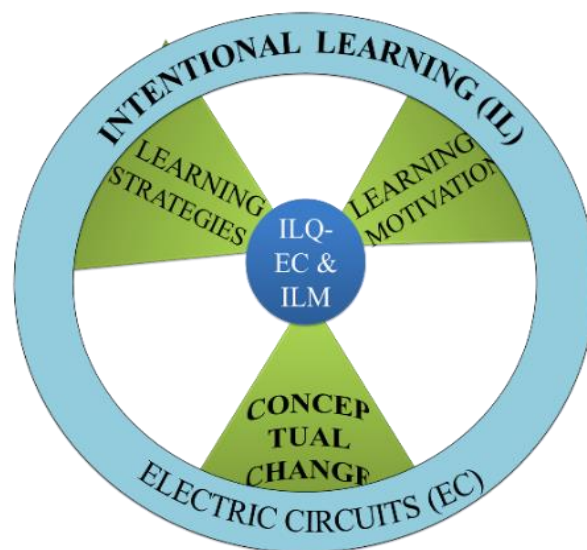
## **2. Brief Review of Related Literature**

In Intentional learning, the student applies the task analysis or has regulation of the pattern needed for accomplishment of task (Tabone, 2009). The intentional learner is described to be self-initiated, goal-directed, and in purposive role with consciousness as to how and why of the learning process (Sinatra, 2003).

Linnenbrink and Pintrich (2003) proposed a framework that merges the cognitive approaches with learner's intentionality. This model is known as "Hot Cognition". This model is different from the traditional cognition which focuses only on the knowledge structure. The "Hot Cognition" model includes the intentionality of the learner to learn. This framework presents the goals that the learner desire to achieve. It also pictures the link between the motivational beliefs and learning strategies used by the learner. The interplay of the constructs showed that the conceptual change became intentional if the achievement goals were coupled with motivation and learning strategies. The model clearly suggests the significant role of intentionality for conceptual change wherein the significant "why and how" of the learning process is attached to the learning task. This model was adopted by McCord and Matusovich (2013) when they developed a survey instrument to measure motivational factors and learning strategies used by students in understanding thermodynamics. Their study design comprised constructs on motivation, learning strategies and conceptual change focused on thermodynamics. They performed statistical tests on motivation, learning strategies and the conceptual change factors. Positive correlations revealed in some items like seeking help from teacher. No correlation in memorizing strategy to the conceptual understanding.

However, factors identified above were different from the result conducted by Bucayong (2016). What came out in the later study were perceived competence and critical thinking factors for motivation and learning strategies constructs, respectively. These factors were based on the

framework which reviewed the link between the motivation and learning strategies to the conceptual understanding which then serve as basis for the development of intentional learning instruments. Specifically, intentional learning instrument for electric circuit concept was developed basing on seven (7) existing instruments found in Self-Determination Theory (2012) which is available online. The instruments have bearing on the assessment of motivation and learning strategy scales and their corresponding subscales. These instruments are Learning Self-Regulation Questionnaire (SRQ-L), Mindfulness Attention Awareness Scale (MAAS), Perceived Competence Scale (PCS), Intrinsic Motivation Inventory (IMI), and Aspiration Index (AI). SRQ-L assesses why people learn or engage in a learning-related behavior. MAAS gauges the importance of consciousness in learning while AI assesses individual aspirations. On the other hand, PCS measures learners' feelings of competence about the activity while IMI assesses the learners experience related to the activity. Framework of the said study is shown in the figure 1.



**Figure 1:** *Intentional Learning Framework (Bucayong & Ong, 2018)*

The framework depicted a wheel wherein the center of the hub represents the aim of the study. The outer rim is the outward indication of inward support variables. Learning electric circuit was intentional because the learners were motivated and consciously engaged in the learning process by allowing them to use their preferred learning strategies. The inward support variables (the spokes to keep the wheel rolling) are learning strategies, learning motivation and conceptual change.

### **3. Statement of the Problem**

The focus of this paper is the development and testing of ILM. This ILM was designed to boost the preferred learning strategies and motivations of the learner for the conceptual understanding of electric circuits. The intervention was therefore conducted in a modular teaching approach and a classroom management that would enhance the perceived competence and critical thinking factors. Thus, the seeks to answer the following specific questions:

1. Do intentional learning instruments enhance teaching and learning process?
2. How effective is the constructed ILM in promoting the conceptual understanding of electric circuits?

Result of the study hopes to provide insights to students on what learning strategies verified to be effective in studying direct current circuit and may serve as benchmark for educators in their teaching approaches. It may also supplement or support for the furtherance of others studies having similar construct.

### **4. Methodology**

The development of ILM involves exploration of teaching and learning approaches which boosted the highly correlated intentional learning factors identified by ILQ-EC instrument.

#### **4.1 Research Design**

Testing the effectiveness of ILM involves pretest-posttest design and structured interview for quantitative and qualitative approaches, respectively. Normal gains served as basis for interpreting level of conceptual understanding and effectiveness of ILM. Qualitative data from the interview substantiate the quantitative data findings along with the comparison of motivation and learning strategies preference between high gainers and low gainers. The scores of the students in answering their modules were also taken as supplementary data.

#### **4.2 Scope of the Study**

Participants were 85 engineering students in two electricity and magnetism classes in Central Mindanao University, Bukidnon, Philippines. However, there were only 75 valid participants in this study since 10 students were removed from the list. Comprising the students deleted were five repeaters, three without pretest and two without posttest. In the interview part, only 12 students were randomly taken from a particular group (high and low gainers) comprising

six students chosen from upper 20% (high) basing normal gains of pretest and posttest and the remaining six students randomly chosen from lower 20% (low) with the same basis. The sample represented the number of distinct subgroups in the target audience (Adler & Adler, 2012) and according to Guest, Bunce, and Johnson (2006) these number could vouch for sufficiency of the needed data.

Determining and Interpreting Resistive Electric Circuit Test (DIRECT) instrument by Engelhardt & Beichner (2004) was used as the assessment tool for the conceptual understanding variable. Thus, only electric circuit topics were considered in ILM making. Modular type of instruction which enhance perceived competence and critical thinking was the only approach given to the intervention group.

#### **4.3 Procedures in Data Gathering**

Researcher explored the educational pedagogies or instructional approaches that could enhance the highest correlated and most predictive factors to the conceptual understanding of electric circuit. The creation of teaching approaches was based on the statements in the ILQ-EC of the identified factors (Bucayong & Ong, 2018). The questions were specific as they easily point a corresponding pedagogy. Appropriate and applicable approaches were patterned in the development of ILM in high contemplation of the factors identified. The constructed ILM was subjected to selected experts in the field of Physics for validity before the actual implementation. The prime purpose of which was to check the contents and other educational norms that a learning module should conform with.

All appropriate research approvals were obtained before the implementation of the study. The ILM was administered in the regular class time following the student's schedule. The student participation was voluntary and with the agreement that all assessment scores during the conduct of the study be credited to their course grade. There was neither lecture type nor any other instructional approaches given except modular type of the concept presentation. Each student was given ILM copy for them to read and answer questions, solve problems or exercises within the prescribed time.

Student's evaluation on the effectiveness of ILM was done after the posttest. The evaluation form has five-point Likert-Scale on three criterions. The scale are as follows; 1 – strongly disagree, 2- disagree, 3- neither agree nor disagree, 4- agree, and 5- strongly agree. The criteria are:

1. The electric circuit ideas were presented in a manner easy for me to follow.
2. The ILM improved my conceptual understanding of electric circuit.
3. I recommend the use of ILM in electric circuit classes.

To strengthen data gathering, interview was conducted after the testing of ILM phase. Driven by the researcher's formulated set of questions, participant's responses were analyzed by pinpointing motivation and learning strategies used. Interview is structured in nature because the interview questions were formulated in order to represent pattern of responses which already been identified and engaged to literature prior to the analysis (Braun & Clarke, 2006).

## 5. Results and Discussions

### 5.1. Quantitative Analysis

The respondents composed of two classes were labeled as section A and section B. To test the significant difference between pretest and posttest, paired sample t-test was done in the two sections separately and then their combination.

#### 5.1.1. Normalized Gain Computations

The DIRECT pretest and posttest scores (as the result of comparison) are shown in Table 1. In section A ( $N = 41$ ), data shows that tests results were significantly different,  $t(40) = 9.21$ ,  $p < 0.001$ ,  $d = 1.44$ . The effect size is substantial to think that students in this section have developed conceptual understanding in electric circuit. On the other hand, t test in section B also yielded significance at 0.001 level,  $t(33) = 7.62$ ,  $p < 0.001$ ,  $d = 1.31$ . This difference presented would signify that there was conceptual learning among the respondents after the administration of ILM.

**Table 1:** Paired t-test comparing DIRECT Pretest and Post test

Section	N	Mean	SD	t value	df	P
A	41	4.54	3.15	9.21	40	0.000
B	34	4.09	3.12	7.62	33	0.000
A + B	75	4.33	3.13	11.99	74	0.000

Normalized gains of DIRECT pretest and posttest scores were also computed to determine the student's level of conceptual understanding not only the comparison of means. According to the study conducted by Hake (1998, as cited by Taganahan, 2014), normalized gain

was not correlated with pretest scores although gain (posttest-pretest) strongly correlates the scores. For section A (N = 41) the average pretest score was 10.83 and 15.39 for the posttest. Pretest scores ranged from 6 to 17 while 10 to 21 for the posttest. Posttest scores demonstrated that students in section A tend to score higher in the test taken for the second time. Comparing pretest and posttest for this section, the average normal gain was 25.10% (Table 2).

Section B (N = 34) got an average pretest score of 10.26 and an average posttest score of 14.35. Pretest scores were ranging from 4 to 16, while posttest scores were ranging from 8 to 21. Comparing pretest and posttest for section B, the average normal gain was 21.82%. On the other hand, combined sections of A and B (N = 75) got an average pretest score of 10.57 and an average posttest score of 14.92. Both sections as combined had pretest score ranging from 4 to 17 and posttest score from 8 to 21. Considering the total number of students, the average normal gain is 23.59%.

**Table 2:** *Summary of Average Pretest & Posttest Scores and Normal Gains*

Section	No. of students	Average Pretest Score	Average Posttest Score	Pretest Score		Posttest Score		Average Normal Gain
				Min	Max	Min	Max	
A	41	10.83	15.39	6	17	10	21	25.10%
B	34	10.26	14.35	4	16	8	21	21.82%
A + B	75	10.573	14.92	4	17	8	21	23.59%

Average normal gains in both sections demonstrated improved conceptual understanding in electric circuits. Although a 23.59% belongs to the category of “low average normal gain” according to Hake (1998), this result was still higher compared to other studies previously conducted with average normal gains lesser than 12% (Lakdawala, Zahorian, Gonzalez, Amit, Leathrum, 2002; O'Dwyer, 2012, Engelhardt & Beichner, 2004; Sangam & Jesiek, 2012; Taganahan, 2014).

**5.1.2. Item Analysis of Direct**

Item analysis was conducted on the posttest scores to assess if the manner of ILM concept presentation influenced this result. For every DIRECT test item, number of students with correct answers were counted and then the corresponding percentage was computed basing on the number of student takers. Difficulty level for every item was determined basing on the



interpreting results guide (Interpreting Test Results, n.d). Item was classified as difficult if less than 30%, moderate if in between 30% to 80% and easy if greater than 80%.

**Table 3:** Test Item Analysis Summary of DIRECT posttest

Level of Difficulty	Number of Items	%	Item Number
Easy	4	13.79%	1, 5, 7, 27
Moderate	19	65.52%	2, 3, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 21, 22, 23, 25, 26
Difficult	6	20.68%	4, 17, 20, 24, 28, 29

Questions in DIRECT test which turned out to be easy questions for the student respondents do not imply that ILM directly answer such questions. Easy questions did not contain multiple concepts but just a simple and direct application of principle which the module also explicitly tackled. On the other hand, difficult questions interlinked concepts which needed detailed breakdown for proper understanding. Nevertheless, the module presented such concepts but not in multifaceted approach which the said difficult items required.

### 5.1.3 Student evaluation of ILM

To test if ILM created positive impact on the students, the respondents rated the module using five-point Likert-scale as shown in table 4. The lowest average ratings were given by students in section B which corresponds to 4.0 for criterion 1, 4.1 for criterion 2 and 4.6 for criterion 3. Nonetheless, result of the evaluation showed that respondents agreed on the positive impact of ILM basing the criterion. Specifically, the manner of concept presentation can easily be followed by students. Students also agreed that ILM helped them in understanding the electric circuit concepts.

**Table 4:** Average scores for each criterion of ILM evaluation

Section	Criterion 1	Criterion 2	Criterion 3
A	4.2	4.6	4.7
B	4.0	4.1	4.6

The researcher verified the association between the normal gains of students and their evaluation ratings with the ILM. Pearson correlation was computed in these variables and result is given in Table 5. There was no significant correlation between criterion 1 and pretest scores,  $r$

(73) = -.01,  $p = 0.908$ . Criterion 2 also showed no significant association with pretest scores,  $r(73) = -.10$ ,  $p = 0.376$ . Similarly, the correlation between criterion 3 and pretest scores was not significant,  $r(73) = 0.021$ ,  $p = 0.860$ . Results showing that pretest scores have no significant association to the ILM criteria means that there was no influence of ILM in the student's prior understanding of electric circuit. This result is reasonable because ILM was introduced to the students after the conduct of pretest assessment.

All correlations between posttests scores and ILM criteria were statistically significant. In detail, there was positive significant correlation between posttest and criterion 1,  $r(73) = .44$ ,  $p < .001$ . Posttest was also positively correlated to criterion 2,  $r(73) = .42$ ,  $p < .001$ . Lastly, positive significant correlation was also computed between posttest and criterion 3,  $r(73) = .33$ ,  $p = .007$ . The effect size of the above correlations was medium according to Cohen's (1998) guidelines.

**Table 5:** Summary of correlation tests result ( $N=75$ )

	Criterion 1	Criterion 2	Criterion 3	Mean	SD
Pretest	-0.01	-0.10	-0.021	10.57	2.56
Posttest	0.44**	0.42**	0.31**	14.9	2.68
Normal Gain	0.43**	0.47**	0.30**	0.23	0.16

Note: \*\* \_ correlation is significant at 0.01 level (2 tailed)

Positive significant correlation between posttest and criterion 1 means that students who could easily follow the presentation of electric concepts in the ILM tend to score higher. The  $r$  squared indicates that approximately 19% of the variance in posttest scores can be attributed to the student's assessment on how the electric concepts were presented in the module. On the other hand, positive significant correlation between posttest scores and criterion 2 means that students who agreed that ILM helped improved their conceptual understanding tend to have higher posttest scores. The  $r$  squared value shows that 17% of the variance of posttests scores can be predicted from the student's assessment of their conceptual understanding after modular type of instruction. In addition, the student's positive opinion on the use of ILM to electric classes can also predict 9.6% of posttest scores difference.

The association of average normal gain to the student's evaluation of ILM was statistically significant. Normalized gain variable was considered to avoid the significant effect of pretest scores (Hakes, 1998). Average normal gain and criterion 1 was positively significant

at  $r(73) = .43$ ,  $p < .001$ ; average normal gain and criterion 2 was positively significant at  $r(73) = .48$ ,  $p < .001$ ; lastly, average normal gain and criterion 3 was positively significant at  $r(73) = .31$ ,  $p = .008$ . Overall, result shows that the improvement of student's conceptual understanding can be predicted from their assessment on the effectiveness of ILM. Students who rated the ILM as helpful also got higher normal gains. Effect sizes of the above correlations were medium to large basing Cohen's (1998) model.

## 5.2 Qualitative Analysis

Data used for qualitative analysis were taken from the interview responses of the subjects. Interview protocol was observed in gathering information.

### 5.2.1. Data Analysis for Low Gainers

Interview data from low gainers were analyzed in order to create a meaningful justification of performance based on the responses of student respondents. From verbatim, points were identified forming data extracts and were then narrowed down and simplified to form data codes (see table 6 for sample coding).

**Table 6:** Sample matrix of interview data for "Low Gainers" respondents

Data Extract	Codes	Category and Description Basing Identified Factors
I am not confident and nervous because of what will be the outcome, maybe I will be successful or failed in the lessons.	<ul style="list-style-type: none"> <li>• No confidence</li> <li>• Afraid of outcome</li> </ul>	<ul style="list-style-type: none"> <li>• Low in perceived competence</li> </ul>
At the start, I did not expect to do well but later I feel comfortable with the topic	<ul style="list-style-type: none"> <li>• Not expectant</li> </ul>	<ul style="list-style-type: none"> <li>• Low in perceived competence</li> </ul>
I am not that really confident but I think I could learn if I wasn't on the back seat	<ul style="list-style-type: none"> <li>• Less in confidence</li> <li>• Learn with location preference</li> </ul>	<ul style="list-style-type: none"> <li>• Low in perceived competence</li> </ul>
I don't usually try to look for justifications of the solutions, I just proceed with reading and understanding the university physics pdf that I have in my mobile to check if my solutions are correct in procedure	<ul style="list-style-type: none"> <li>• High dependence on learning materials</li> <li>• Less tendency to justify</li> </ul>	<ul style="list-style-type: none"> <li>• Low in critical thinking</li> </ul>
I usually follow the specific formula for such problem to arrive with a result	<ul style="list-style-type: none"> <li>• Procedural learning</li> </ul>	<ul style="list-style-type: none"> <li>• Low in Critical thinking</li> </ul>

Majority of the low gainers comments were "*I am not confident and nervous because of what will be the outcome, maybe I will be successful or failed in the lessons*", "*no, I don't*

*understand some lessons” and “I don’t expect to do well because I don’t understand some lessons”, which then coded as “no confidence”, “afraid of outcome”, “lack of understanding” and “not expectant”, respectively. From the learning strategies and motivational factor operational definitions, these codes were then classified and described to be “low in perceived competence”, and not critical thinker, accordingly.*

**5.2.2. Data Analysis for High Gainers**

The same approach of data analysis was conducted for high gainers (see sample codes in table 7). From the verbatim, the following data extracts were generated: *“I feel confident because I had it in my high school years” and “I expect to do well in this topic because I need this for my personal gain and foundation as a future engineer”*. Considering the operational definition of learning strategies and motivational factors under study, the respective codes for these extracts were categorized as “high in perceived competence”. On the other hand, codes for *“I have the tendency to look for alternative ways to solve the problem” and “I ask questions both in mental and vocal”* fall under high in critical thinking category.

**Table 7:** *Sample matrix of interview data for “High Gainers” respondents*

<b>Data Extract</b>	<b>Codes</b>	<b>Category and Description Basing on Identified Factors</b>
I feel confident because I had it in my high school years	<ul style="list-style-type: none"> <li>• confident</li> </ul>	High in perceived competence
I expect to do well in this topic because I need this for my personal gain and foundation as a future engineer	<ul style="list-style-type: none"> <li>• personal gain</li> <li>• confident</li> </ul>	High in perceived competence
I have the tendency to look for alternative ways to solve the problem	<ul style="list-style-type: none"> <li>• resourceful</li> </ul>	High in critical thinking
I ask questions both in mental and in vocal	<ul style="list-style-type: none"> <li>• Inquisitive</li> </ul>	High in critical thinking

**5.2.3 Data Analysis on the assessment of ILM**

Responses of the respondents regarding the use of ILM were also analyzed to create a meaningful justification of its impact on conceptual understanding. From verbatim, points were identified forming data extracts and then simplified to form data codes. Moreover, data codes

were used to describe the effectiveness or influence of module in understanding electric circuits. Sample matrix presentation of these data is shown in table 8.

Example of data extracted from verbatim of low gainers regarding their responses about the module is “*the intentional learning module was helpful in learning electric circuits because examples are easier to understand*”. This was coded as “learning aid” and “type of example.” Basing this respondent’s statement, the module can be described as “helpful in learning” and provides “easy examples”. Other points extracted from data were coded as “learning ideas” and “guide questions”. These codes showed that the module provides learning ideas and open ended questions which guided the respondents in understanding electric circuit concept.

**Table 8:** Matrix of interview data for the assessment of ILM

Data Extract	Code	Module Description	Category of Learners
The ILM is helpful in learning electric circuits because examples are easier to understand.	<ul style="list-style-type: none"> <li>• Learning aid</li> <li>• Type of example</li> </ul>	<ul style="list-style-type: none"> <li>• Helpful in learning</li> <li>• Easier examples</li> </ul>	Low Gainers
I read carefully the module in understanding the concept.	<ul style="list-style-type: none"> <li>• Conceptual understanding</li> </ul>	<ul style="list-style-type: none"> <li>• Helpful in concept learning</li> </ul>	Low Gainers
The ideas in the module can easily be understood and really useful for follow-up questions.	<ul style="list-style-type: none"> <li>• Learning ideas</li> <li>• Guide questions</li> </ul>	<ul style="list-style-type: none"> <li>• Understandable ideas</li> <li>• With open-ended guide questions</li> </ul>	Low Gainers
The module makes us aware and knowledgeable about electric circuits.	<ul style="list-style-type: none"> <li>• Awareness and knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Provides awareness and knowledge</li> </ul>	High Gainers
I learned the concept of electric circuit by following and studying the module itself.	<ul style="list-style-type: none"> <li>• Concept presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation of concept can easily be followed</li> </ul>	High Gainers
Ideas presented was in a manner uneasy to follow because problems are difficult	<ul style="list-style-type: none"> <li>• Presentation of ideas</li> <li>• Problems</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation of concept cannot easily be followed</li> <li>• Difficult sample problems</li> </ul>	High Gainers

High gainers consider the module with these descriptions, “*provides awareness and knowledge*”, “*presentation of concept can be and cannot easily be followed*”, and “*difficult sample problems*”. In the module descriptions part, data extracted from the verbatim statements of respondents generates similar codes. There was only one respondent who indicated that the module was hard to follow and the problems were difficult. However, majority of the respondents consisting high and low gainers attested the positive contribution of ILM in conceptual understanding of electric circuits.

Table 9 shows the summary of the interview result. It was revealed that factors like critical thinking and perceived competence truly affect ones learning. Low gainers were not as confident as the high gainers. Their self-evaluation affects their level of understanding leading them to get lower scores. Low gainers also did not manifest high critical thinking.

**Table 9:** Summary of respondents’ responses during interview

Respondent	Learner Category	Critical thinker	With Perceived Competence	Rated ILM to be Effective
A	High Gainer	√	√	√
B	High Gainer	√	√	√
C	High Gainer	√	√	√
D	High Gainer	√	√	√
E	High Gainer	√	√	√
F	High Gainer	√	X	√
G	Low Gainer	x	X	√
H	Low Gainer	√	√	√
I	Low Gainer	x	X	√
J	Low Gainer	x	x	√
K	Low Gainer	x	√	√
L	Low Gainer	x	x	√

Interview result was in agreement with the correlation analysis part previously shown. Successful learners were critical thinkers and high in perceived competence, which in contrast, learners who were not critical thinker tend to have lower performance. With regards to the module, both low and high gainers testified on the effectiveness of the Intentional Learning Module. Both learners attested an improved understanding through the module basing normal gains.

## **6. Conclusion**

Results of the study provide information relevant to teaching and learning in the context of electric circuits. The presentation and learning approaches of ILM focused on how to heighten the student's critical thinking and confidence in understanding electric circuits. Significant difference between pretest and posttest scores and the average normal gain showed evidences of conceptual understanding of the student-participants. Interview data supported the statistical results. Qualitative analysis revealed that high gainers tend to be more critical in their learning approach and with positive outlook of being able to perform well. The fact that majority of them were critical thinker and had a strong perceived competence, combination of the two factors gave way for high gainers to be a high gainer.

Evaluation done by students confirmed that ILM both influenced the low and high gainers in their learning gains. Results thus implied that instructional modules should not contain so much texts that require just rote learning but more on critical thinking language to promote reasoning. Even modular type of instruction should infuse critical thinking skills for conceptual learning.

Moreover, the present study focused only in electric circuits topic, future researches may consider ILQ-EC to explore motivation and learning strategies factors in other topics or subject areas not only in physics.

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