Morphological and Syntactic Meaning: An Interactive Crossword Puzzle Approach

Ibrahim Garba

Abstract—This research involved the use of word distributions and morphological knowledge by speakers of Arabic learning English connected different allomorphs in order to realize how the morphology and syntax of English gives meaning through using interactive crossword puzzles (ICP). Fifteen chapters covered with a class of nine learners over an academic year of an intensive English program were reviewed using the ICP. Learners were questioned about how the use of this gaming element enhanced and motivated their learning of English. The findings were positive indicating a successful implementation of ICP both at creational and user levels. This indicated a positive role technology had when learning and teaching English through adopting an interactive gaming element for learning English.

Keywords—Distribution, gaming, interactive-crossword-puzzle, morphology.

I. INTRODUCTION

MORPHOLOGY and syntax are generally agreed features of language studies [1], [2]. Arabic and English language have similar and dissimilar features [3], [4]. The challenge is how learners who speak Arabic can understand such similarities in order to reduce the time it takes to teach/learn English. This can be solved through solving interactive crossword puzzles activities that:

- aid understanding units of meaning,
- provide practice with ordering and sequencing phrases or sentences.

The ICP has forms which provide learners an opportunity to experiment with the language. This increases motivation, engagement and enjoyment of the learning process.

Learners that engage with such content designed to challenge their cognitive abilities through arranging, guessing, and referring to previous knowledge will find the activity both enjoyable and motivating. They are created based on linguistic frameworks which teachers can always fall back on when designing materials to be used to practice English in the classroom. A focus on puzzles in the classroom tends to focus on how to use the internet to find items that students can use to practice a specific skill or how vocabulary items and how they are used to motivate learners. Teachers start at the technology already available and work backwards. However, this investigation observes harnessing technology with principles and frameworks that govern the creation of materials for the language classroom successfully.

Studies on implementing crossword puzzles in the learning environment such as the classroom have been extensive and successful. The impact of this extensive success has been highlighted in the works that both describe [5] the procedure, its successes [6] which reflects positively on the most important element, learners. On the other hand, the use of linguistic frameworks on the design of content, its usage, activities, their stages, and types of mental operations learners will be involved with have been separately researched [7]-[10].

As the two fields of interactive crossword puzzles and materials design have been successfully researched, this study aims to incorporate language teaching principles for materials design with successfully published work on the use of crossword puzzles in the classroom environment.

II. REVIEW OF THE LITERATURE

Research into how the use of templates for learners to create their own puzzles which allows learners to practice the language elaborated on how crossword puzzles allowed learners to develop language awareness and language learning awareness through using Hot Potatoes [11, p. 178]. In this situation, focus has mainly been the authoring tool itself. Other work in the area investigated the elements [12] of puzzle creation that enhanced content of crossword puzzles that provided positive student feedback and better student learning such as deep strategy [13]. There has been a positive review of using puzzles as quizzes for reviewing taught content [14]. This included how they can be used as games in the form of active learning [15] where deep strategy was discovered to improve student learning and an increase in motivation [13]. More significant research on how crossword puzzles in particular are used with subject content can be found to investigate the gaming element [16] of using technology [17]-[20] such as crossword puzzles to improve academic results in the language classroom. It has gone into detail describing the actual success [21] of learners who have used crossword puzzles and the attitudinal beliefs of both instructors and learners in using technology for language learning. However, their study has not investigated the combination of including how theories of linguistics inform the preparation of content for interactive crossword puzzles to be used in the classroom to review content.

This paper aims to further the use of interactive crossword puzzles as a means of integrating technology within education to motivate students with enhanced content for learning English by applying current research into materials design to inform the creation of content that will be engaging,

Ibrahim Garba is with the King Abdulaziz University, Jeddah, KSA (e-mail: meta_tag@yahoo.com).

motivating as well as enriching. At present, most research in language learning material design focuses on printed material as well as material that will be prepared by teachers to teach in the classroom [22, p. 98].

The approach is for content to be created using specific frameworks that enhance the design process by analyzing the material used in terms of the principles of turn taking, participation, and mental operation as outlined by Littlejohn. The established taxonomy of Bloom is adopted in the content selection process in order for student learning to be objectively monitored. After creating the puzzles, the students and teacher use the puzzle in the classroom. A 5 point Likert [23] scale questionnaire is used to get students' feedback and classroom observations and recordings are used to gain further feedback.

The results from this study indicate that both linguistic principles when adopted favor teachers' to positively analyze and develop material that can be used in language teaching courses successfully. The results also show that students have successfully enjoyed learning and interestingly discovered the different strategies they can employ when learning English by drawing on similarities between Arabic and English.

This research can further be developed to include how content can also be analyzed for interactive usage in the language classroom for enhancing and motivating learners for other language skills.

III. MATERIALS AND METHOD

The method described here is based on preparing crossword puzzles or contents using a word processing tool. Compiling them was done with a crossword compiler. The analysis of the content based on task analysis created by Littlejohn. This analysis would allow the materials design framework based on linguistic theory to inform the creation process and aid the engagement, enrichment and motivation of student learning. There were four stages involved in which included:

- creating the content by selecting fifteen chapters from an English course book, creating the interactive puzzles as a document and using a compiler to create, implement and upload the content,
- analyzing the content which involved what nine students from a language department at a university in Saudi Arabia would do with the content, how they would use it, when they would use it and with whom
- using the puzzles,
- creating the questionnaire, collecting the feedback, observing based on the content analyzed in the earlier stage and documenting.

A. Content Source

Creating puzzles was done using the course material as the source. The students were placed on the course using a placement test that was designed to ensure that students of pre-intermediate English level were on the course. As the experiment was designed to study whether the content would be enriched and students would satisfactorily be motivated and engaged, it was important to ensure content source was based on what students covered on their program. As students on the

course in the past had struggled with the items like vocabulary, language use and grammar, these items were selected as items for the content source. Creating 10 puzzles per chapter resulted in 160 questions covering the 16 units.

B. Content Design

Using the content source to create the input for the puzzles and provide clues for students were designed as word documents. Students were required to complete gap fills, rearrange sentences, and sequence letters to spell words.

C. Puzzle Clues

The puzzles clues were designed based on ensuring students higher order thinking skills were engaged. Though the content were from the course book, the clues were based on the following taxonomies based on Bloom:

1. Knowledge

Each time students spelt the words in the puzzle they recalled the word taught in class and tried to match what they knew to the actual words required to solve the puzzle An example of this was when they spelt TRAFFIC which checked they could remember the letters 'A', 'I' and the double letter 'R'.

2. Comprehension

This took place when jumbled up words needed to be placed in the right order to form a correct sentence. By doing that students revealed the hidden words such as the one below:
- 'I used to play tag' will have the letter 'S N A K E' jumbled in. The mixed sentence will look like this;
  (N) used, (K) play, (S) I, (E) tag, (A) to.

By students unraveling the jumbled sentence they were also demonstrating their comprehension at two levels, grammatical and spelling. So, 'I used to play tag' represents 'S N A K E' which is the word they uncovered in the jumbled sentence.

3. Application

By students working in pairs and discussing the clues in relation to the selected unit they were solving the puzzles as well as experimenting on the best sentence that will either unravel the hidden word or sentence. Sometimes a basic definition was needed so students could solve the puzzle. For instance, the word pollution can be described as dirty air which would mean students had to count the number of letters in the word and spell it.

4. Analysis

Through the separate words or parts of the sentences students were always challenged to infer and support their answers by working in groups and guessing. These last two points are lacking in most students where the transfer from a different learning environment left all forms of learning control in the teachers' hand to an interactive use of the content that students covered in class but were now asked to categorize and control at their own pace of learning. An example of this is in a simple crossword where three or more words are given and students are asked to select the one that does not fit the group.

An important point to consider was that a single set of puzzles in a particular context would also test any set of competencies. For instance, having a sentence with a verb missing which in turn formed the missing word in the puzzle made students try to understand what was the general meaning of the sentence, compare previous knowledge with what was presented to them, approach the subject from a certain angle dictated by the questions which drew out what they knew, and finally, detected the problem solving ability through their application of what they knew of the subject. In other words, students were demonstrating what they knew, comprehended, applied, and analyzed respectively through discussing with one another about a particular word, word-order, letter or tense.

D. Compiling and Uploading

Compiling the content as crossword puzzles was done using a compiler that could save and include java and web hosting capabilities. There were many compilers available but lacked the ability to save in different formats required for the university browsers. Uploading the content was carried out as archived folders which were finally uploaded and unpacked on the university website.

E. Evaluating

The final stage of creating the puzzles involved evaluating and testing to ensure unpacking, linking and arrangement online was successful for students and teacher to use.

F. Content Analysis

Once the content had been created and in order to validate the research objective, the content was analyzed using the following process to determine:
- how the content could be used,
- how students would use them in the classroom to allow their feedback to be collected,
- the nature of language items used so that the ICP can themselves be analyzable as successfully based on informed language teaching principles.

Upon completing the evaluation and analysis, the crossword puzzle was introduced to the learning environment and electronically used in the physical classroom. The approach used was to have a group gaming session after completing each chapter. Students consulted with each other before suggesting answers to the instructor who ran the interactive crossword puzzle in class. The running of ICP as a review tool was done in a fun gaming atmosphere.

After one academic year of learning, evaluation and statistical analysis was carried out through the use of questionnaires, interviews and observation of student's results from their examinations. The results were tabulated from the sample, using excel, which were used for interpretation in conjunction with the research write up. They also form the basis for conducting both the qualitative and quantitative analyses of the data.

Nine students attended the course and they also had other courses and demand on their time. As well as using booking computer labs during their normal sessions, students were required to use the electronic puzzles during class. There were some technical issues between java and some browsers which meant that the same classroom could not always be used.

The approach taken to combine both linguistic principles and technology to create content that enhances, motivates and makes learning enjoyable is unique in this paper.

IV. RESULTS

Each item from the ICP was based on the same source. This meant that the ten items used to create the ICP would maintain consistency in their content types. Each chapter had vocabulary, language use and grammar items. The analysis made on the items would therefore be consistent across the sixteen chapters. For example, the source of material students was using throughout the experiment was the ICP which included the ten specific instructions and items created for them to use. On this basis, the analysis of the crossword puzzle from a linguistic perspective using the framework expounded three points:
- the materials did what they were set out to do,
- students' precise roles were defined as well as what they were supposed to do while using the puzzles,
- teacher's role and what was expected from the teacher was also defined

Fig. 1 ICP cyclical usage phases

A. Content Analysis

A key finding is the combination of what learners were expected to do with the ICPs, the mental operation involved with the ICP as they used them. Other important elements included the interaction during the sessions between learners and teacher, with learners and one another and the actual creation of the content using the technology. These key findings highlighted in Fig. 1 show the relationship between how students discussed with one another and the instructor in the beginning of the session in order to clarify their roles and turn taking strategies. This was important when designing content for language use because when these were not clear the communication in the classroom would be affected. As soon as students read the puzzle clues, they engaged in mental operations that included guessing, semantic decoding, hypothesizing about possible language meaning. The analysis

indicated that they would also engage in competing with one another not to lose face. They used the ICPs and produced oral and written outputs as part of the interaction phase.

The puzzles created demonstrated that students would take turns discussing the meaning of each item on the puzzle 100% by taking a direct role of responding to the items on the puzzles, creating their own responses, sharing the responses discussing who keys in responses. The results also highlighted that students would focus 80% of their effort on meaning, form and relationship of the words in phrases and sentence activities. 76.67% of the items focused on mental operations. While 60% of learners used the puzzles in pairs, 100% of the activities were done as a group. All output was oral and written.

The results extrapolated from the questionnaire indicated that 42% of the students (SD. 1.58) strongly felt that using the ICP motivated them on the course. This finding can be significantly related to how 58% (SD. 2.34) of the students strongly agreed that the use of ICP better helped them remember content. Fig. 2 highlights the findings of the two questions regarding whether ICP usage motivated learners and aided them to remember the content taught. It is significant to note the general trend tending more towards agreement for both questions as well as a slight tendency of some students who did not find the ICP motivating or useful for remembering.
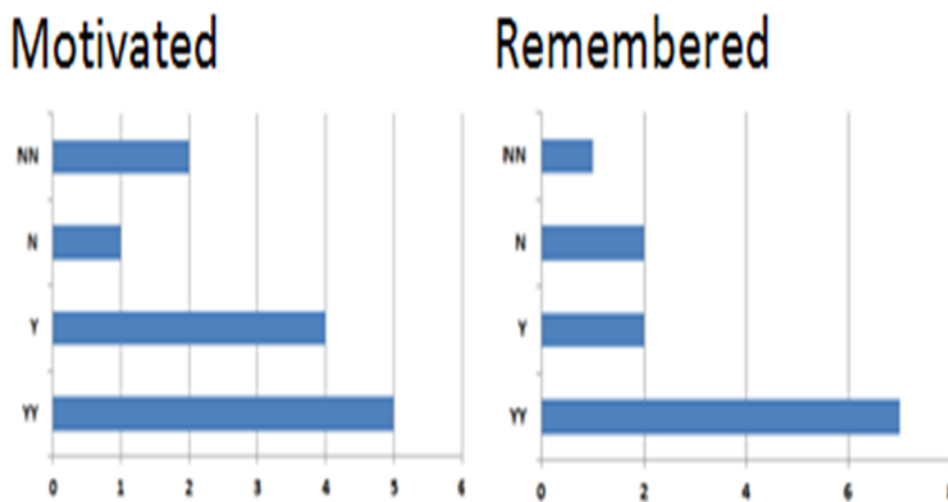

Fig. 2 Using ICP to remember and motivate

The actual creation of the content using the course book proved to be challenging. The transfer from a word document to the software was straight forward.

B. Classroom Observation

Overall the main features of the classroom observation of students using ICP for revising was positive. They solved questions that required them to remember easily where they had to complete the space provided using the clues provided to guide them. The more challenging puzzles such as sequencing and rearranging words that led to solving vocabulary items were challenging. An important aspect of this challenge is summed up by a student comment:

"It's hard but I did it… because I need to read."

This mental effort of being forced to read and count the number of letters and more importantly read the complete sentence was a remarkable finding. Usually students assume the answer is the key to communicating and once they understand the answer, they do not need to understand the relationship of the rest of the words to provide a more complete and meaningful thought. On the whole, the observations also showed that students operation while trying to decode semantic through sequencing both letters and sentences, brought about a distinction to their language awareness. Where they would mix the different forms of auxiliary verb *be* in the past passive, they were directed to use it as part of the clue to discover a crucial vocabulary item. This meant that while in Arabic the verb is nonexistence, students had to make mental notes to acknowledge its existence and where to place it on the sentence because it was in the puzzle clue.

Individually, the students read and completed the questions they selected to answer for their group. They solved the puzzles after 5 minutes and gradually increased to 10 because they had more to read in the clues as the chapter and difficulty of the course gained momentum. However, they also continued to read and discover what meaning was behind the clues provided.

There was an apparent failure of the ICPs to provide options for students to see which word family was required. For instance, they solved puzzles that required them to use the adjectival form of a word using its noun form. So they would provide employment instead of employed and as they counted the words they discovered that it was the wrong item to use but from the correct word's family.

The students' general attitude towards the role ICP played during the session was favorable:

"..It was good. It was interesting. Because make me improve how to spell words and remember the words. It was fun."

The response was spontaneous, made after using the ICP to revise and the students comment indicated how he was affected when recalling information that was used to compete with his classmates. The level of competition was always high and positive because students did not want their teams to lose. A student commented that:

"*It was good. More interesting to compete with my classmates,*"

They also enjoyed the individual roles it allowed them to play because:

"*Good... because I answered all the question*"

Fig. 3 corroborates the mood of the attitude of students when asked whether they enjoyed using the ICP. 34% (SD 2.12) of the students agreed strongly that they enjoyed using ICP and while 50% of them agreed that it was enjoyable, what is significant is the combined number of students who did not enjoy using the puzzle mainly because it was new and they were forced to read.
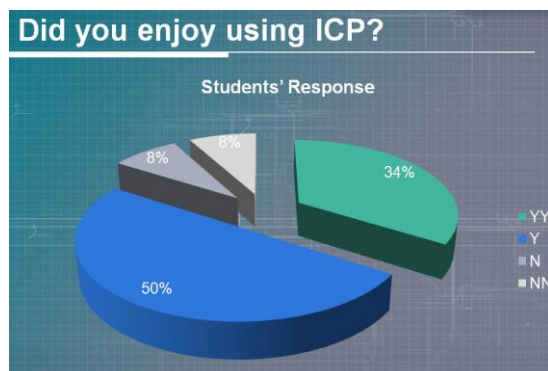

Fig. 3 Result of students who enjoyed using ICP

V. DISCUSSION AND RECOMMENDATION

The main objective of this paper was to investigate students understanding of English morphological and syntactic meanings in activities created as interactive puzzles. Creating content based on language teaching principles for materials design also leads to students' motivation increasing as a result of being engaged with the content. This enhances their understanding of words, phrases and sentences.

While research has shown that materials designed for students and teachers to know what they will do with it, how and in which mental operations were involved, this research demonstrates the possibility of integrating both content for language learning as well use of technology in education such as interactive crossword puzzles. For instance, classification of words as either nouns, verbs or the particles in Arabic greatly affects the understanding of words in English.

All the students struggled with the reading because they were relating the reality of what they knew of the real world with linguistic meanings, or arbitrariness. This has affected the way students order words and their choice of words to make meaningful sentences in English. However, the nature of the content used were not fictitious and represented real life possibilities rather than abstract and lacked representation for the words they were trying to read and recall. The task sheet

used to analyze the content confirmed that and provided possibilities to help the two students struggling with the task. For example, where students had problems with comprehension, the mental operation required included hypothesizing and trying to recall what seems like basic word ordering. The teacher noted this, and provided extra activities for the student concerned based on exercises that fitted his language need at the time. Other students struggled with understanding how adjectives were used in English for instance and they were provided with extra practice through the use of the ICP.

The gaming atmosphere, the competitive edge as well as recalling previously taught material using the ICP has significantly affected their learning.

The data suggests that students' participation improved their English and motivated them to study. Garba [19] determined success based on blending technology with face to face sessions, while [16] expounded on the use of edu-gaming such as crosswords and simulations to aid and motivate learning. We find that crosswords have also enhanced students' results as discussed by [21]. The extremely significant contribution of the use of language teaching principles towards materials design brilliantly elucidated on the techniques involved when determining what is behind language teaching content.

This research discloses a significant contribution towards combining what the elements necessary for the language teacher in particular needs to focus upon when designing content for use in the classroom.

All the content used demonstrated 100% the mental operation involved when using words, phrases and sentences to create meaning that aids students revise such that they enjoyed it, were motivated to continue and focused on improving their abilities. These findings highlight an important step forward for English learning materials to be integrated with technology to create interactive content. This significance can enable practitioners to use technology knowing the components that will be affected between the learner, teacher, content, and the platform used.

Although this was a study of a small section of the university population, it can be extended with a wider population to investigate inter-language of English language learners.

APPENDIX

The following figures include the archived folder, analysis task sheet, key framework task sheet, samples of puzzles clues created, ICP hosted on the university web site and student questionnaire respectively.

Fig. 4 Sample archived folder with content types

Task Analysis Sheet										
Interactive Crossword Puzzle										
Question	1	2	3	4	5	6	7	8	9	10
I. What is the learner expected to do?										
A. TURN-TAKE										
Discuss correct word	\	\	\	\	\	\	\	\	\	\
Provide correct sequence of letters	\	\	\	\	\	\	\	\	\	\
Discuss who answers questions	\	\	\	\	\	\	\	\	\	\
B. FOCUS										
On language system (rules form)	\	\		\	\		\			\
Meaning	\		\	\			\	\	\	\
Meaning/system/form/relationship		\	\		\	\	\	\	\	\
C. MENTAL OPERATION										
Decode semantic meaning	\	\	\	\	\	\	\	\	\	\
Decode sequencing of letters	\		\			\	\	\	\	\
Decipher puzzle clues	\	\	\	\	\	\	\	\	\	\
Select correct answers (individually)	\		\	\						
Retrieve from LTM	\		\	\			\			\
Hypothesize to determine meaning	\	\	\	\	\	\	\	\	\	\
Repeat pattern			\				\			\
Research - (consult with one another)	\	\	\	\	\	\	\	\	\	\
Compete (not want to lose face)	\	\	\	\	\	\	\	\	\	\
II. Who with?										
Learners in pairs	\			\	\		\			\
Learners with one another (group)							\			\
Learner to class	\	\	\	\	\	\	\	\	\	\
Teacher to learners										
III. With what content?										
A. INPUT TO LEARNERS										
a. Form										
Letters / words / phrases / sentences: ICP	\	\	\	\	\	\	\	\	\	\
Extended discourse: oral	\	\	\	\	\	\	\	\	\	\
b. Source										
ICP	\	\	\	\	\	\	\	\	\	\
Learners	\	\	\	\	\	\	\	\	\	\
c. Nature										
Course content	\	\	\	\	\	\		\	\	
Fiction		\	\		\	\		\		
Non fiction	\			\			\			\
B. OUTPUT FROM LEARNERS										
a. Form										
Letters / words / phrases / sentences: oral	\	\	\	\	\	\	\	\	\	\
Letters / words / phrases / sentences: written		\			\		\			\
Letters / words / phrases / sentences: typed	\	\	\	\	\	\	\	\	\	\
b. Source										
ICP	1	1	1	1	1	1	1	1	1	1
Learners	1	1	1	1	1	1	1	1	1	1
c. Nature										
ICP	1	1	1	1	1	1	1	1	1	
Fiction		1	1		1	1		1	1	
Non fiction	1			1			1			1

Fig. 5 Linguistic framework analysis of content task sheet

Chapter Eight Solution

Across

2. Fall is the... when children often go back to school.

6. We ...Eid by praying in an open area.

7. July and August are the months many families take summer...

9. (A) is a (D) Ramadhan (Y) month

10. Eid is a day when many people ... a lot of sweets.

Down

1. Laylatul Qadar, is a night when some ... stay up all night and pray.

3. A couple goes on honeymoon ... they get married.

4. Ramadhan is a month when Muslims...

5. A man and a woman get engaged ...they are married.

8. (N) are (A) July and August (D) months.

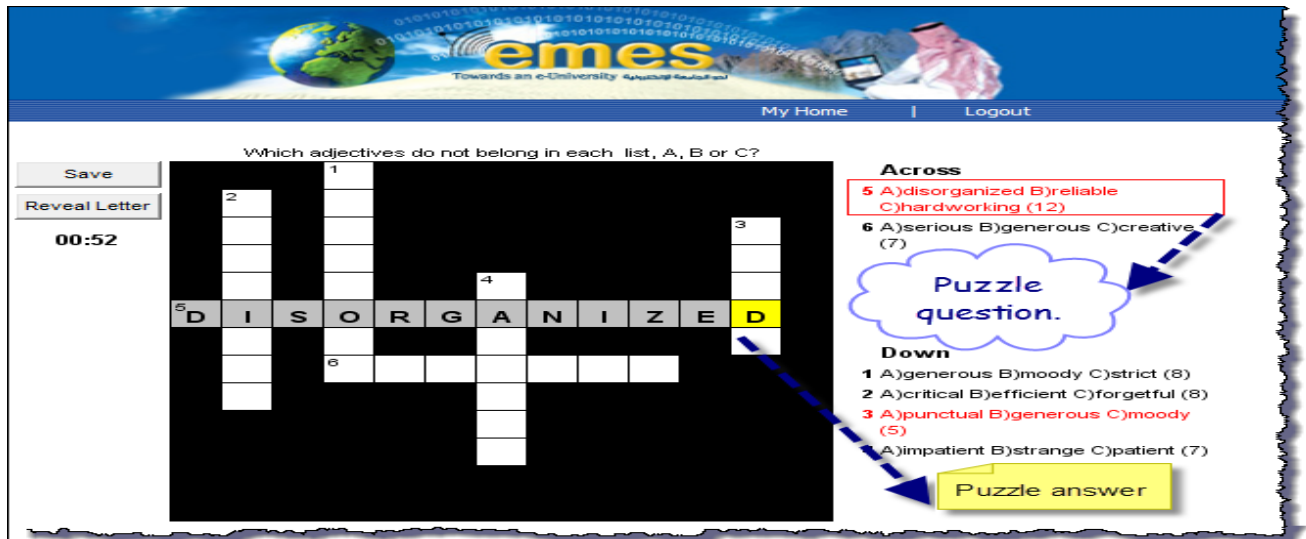Fig. 6 Sample crossword clues and solutions (no instruction)

Fig. 8 University hosted puzzle with student guide (with instruction)

Interactive Crossword Puzzle Survey

Objective

The objective of this survey is to evaluate effectiveness of using Interactive Crossword Puzzles (ICP) in improving the teaching and learning environment.

Instruction

This is a three part questionnaire. Answer all questions by selecting or providing the appropriate response.

Part One:

1. The ICP made my course more enjoyable.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

2. ICPs made me motivated to learn the course.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

3. ICP made me better remember each key concept.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

4. ICP made me better recognize each key concept.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

5. ICP made me better differentiate each key concept.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

6. The time allocated in class, was sufficient to complete each ICP effectively.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

7. The ICP was used in class at the right time.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

8. The ICP was easy to find in EMES.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

9. The ICP was easy to run (operate).
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

10. The ICP were easy to use in EMES.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

11. The ICP made me prefer to learn in a group compared to learning using ICP on my own.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

12. Learning using ICP in a group gives additional benefits compared to learning using ICP on my own.
1 – strongly agree
2 – agree
3 – neutral/no opinion
4 – disagree
5 – strongly disagree

Fig. 9 Sample students using ICP

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