Imagine you are in the world of Sherlock Holmes or Hercule Poirot, you do not glance upon a crime scene and with your very next breath reveal the perpetrator and motive to the police authorities who are scrutinizing each word and gesture. Students, no matter how well equipped with knowledge and pressure of test conditions, encounter this situation where they will read an unseen mathematical question in a test or examination. Students are expected within a few seconds to comprehend the context; follow a correct protocol and conclude with a logical solution that will be graded by the instructor. Unfortunately, not all students can perform well under such intense pressure, so Curtin College in Stage One Mathematics has introduced a scheme where a hint or clue can be exchanged for the allocated marks for that part of the question. Anxiety can affect students who consequently may be unable to write a solution befitting their level of knowledge, even with a sheet of notes under timed test conditions. Using Bloom’s and SOLO taxonomy, this paper will endeavor to illustrate the use of ‘clue giving’ under no time limits may benefit both students and educators learning experience.

Keywords: Bloom’s taxonomy, SOLO taxonomy, Untimed test conditions.

1 INTRODUCTION

Have you ever tried using the instruction leaflet to put together a piece of gym equipment or a child’s bicycle? At the start, you feel confident you had all the pieces in order ready to assemble and then you start reading instructions. All appears to go well until you come to one instruction that does not appear to make sense, you look at the piece, then back at the words, repeat a few times and then ask for help via google or another person. This extra insight then helps you to complete the task and finish the assembly of the item.

The same situation may happen in a test when a student just cannot understand or think how to start or proceed with a question. Now add the time factor which produces the added pressure of “must think quickly” attitude or I won’t finish the questions. Students will rush to read the questions in order to start writing and not wasting time and often miss vital information contained in the test paper itself or on their own allowed sheet of notes. This could be one of the reasons for blank spaces in test and examination papers.

The idea of giving clues has been recently introduced (students usually have their own sheet of notes) and the hope is to avoid blank spaces on the test paper. This qualitative paper will discuss how it has been implemented and why it provides feedback to both the student and educator and thus it can be viewed as a learning tool as well as an assessment.

2 METHODOLOGY

Curtin College is an alternative pathway to enter the first or second year of Curtin University to complete studies in Health Sciences, Commerce, Engineering and Information Technology degrees. The student’s ability levels are similar to any secondary level education with a range of prior mathematical knowledge and mixture of mathematical capabilities.

Although, students may reflect on the best ways they perceive they learn a topic and retain information, they do not necessarily notice the progress they are making during the learning process. In the early years of education, learning style is strongly influenced by educators and the most common strategy told to students is “practice makes perfect”. This is somewhat just a procedural viewpoint and does not consider the potential harm to weaker students. The more incorrect attempts at questions about the same topic may reinforce errors rather than eliminate them and thereby erode confidence in ability thus leading to “cannot do mathematics” attitude. Learning is multi-layered as a blend of mental, emotional and physical attributes rather than just practice.
The classes are interactive and involve students in collaborative work standing at whiteboards, working with Manipulatives at the tables, giving explanations to students on their table or to the whole class. The clues are currently being trialled during tests rather than the final examination as we have smaller class sizes and are not restricted to a 2 hour time limit. This paper will focus on one test worth 10% involving mathematical progressions and continuous exponential growth. These two topics will appear in the final examination conducted about three weeks after this test. This is a perfect opportunity to transform an assessment challenge into an appropriately timed personal learning moment.

The following describes an action sequence that asking for a clue may follow:

1. Student raises hand and points to the relevant part.
2. Teacher checks to see if the information is contained on the sheet of notes
3. If the information is there, teacher can give the student the opportunity to find it
4. Teacher can point or underline relevant details without saying or writing anything more
5. Students can elaborate on ideas to the teacher
6. If required, write formula or values and ask students to say the relevant meaning
7. Teacher checks that the student understands before leaving the student

3 THE QUESTION, THE CLUE, AND THE TAXONOMY DOMAIN

In order to provide the reader with a more coherent idea of how the practice of “clue giving” relates to Bloom’s taxonomy and Structure of the Observed Learning Outcome Taxonomy (SOLO), the next sections will combine the relevant taxonomy descriptions with the methodology and examples of questions and clues. Here is just a brief overview of the each taxonomy:

Bloom proposed three main domains, Cognitive, Affective and Psycho-Motor, this paper will concentrate on Bloom’s Cognitive Domain. The mental aspect, where the levels start with remembering and understanding, then applying and analysing, through to creating methods and evaluating the solution’s significance [1].

SOLO taxonomy helps students and educators discover the extent and progress of the comprehension of a particular topic by reviewing their solutions. The content of any answer, correct or incorrect reveals the depth of understanding in how they have inter-related and organised the individual parts. There are five levels starting at the lowest level, Pre-structural, Unistructural, Multistructural, and Relational through to Extended Abstract [2].

3.1 Example Questions on Mathematical Progression and Exponential Growth

For the purpose of this paper, the parts of the questions have been labelled a) through to e) in order to reference the part of the question easier and cause less confusion between questions.

An athlete preparing for a triathlon has started training for each of the parts swimming, cycling, and running. For the cycling leg, she starts on the first training day with a cycle of 20 km and then increases her distance by 4 km every day.

a) State the formula that you will use to calculate on which day she cycles 100 km

b) To gain full marks, use the formula stated in part a) to calculate on which day she cycles 100 km.

c) Determine the total distance that she would have cycled from day 1 to day 14.

3.2 First type of clue

Although, this heading is “First Clue”, this does not necessarily mean that this is the first clue a student will ask for during the test. The paper will discuss the clues in conjunction with increasing levels within the domains of Blooms and SOLO Taxonomy respectively. Please note that not all domains will be discussed in this paper since a student functioning at a higher level in a topic will likely not need a clue to complete the question. The beginning of the question for a student is similar to the start of writing an academic paper the ideas are in your head, but the first few words are very difficult to type! Please keep in mind that the test is untimed so the pressure of time is not a burden to the student.
Question Requirement

Part a) involves a straightforward step of recognising this is an Arithmetic Progression and finding the formula on the sheet of notes.

Taxonomy Level

Bloom’s Cognitive level is recognising and remembering to distinguish between the formula required, is it a term or a sum of the progression?

SOLO level could be Pre-structural is simply the collecting of the materials in order to solve the problem, just transcribing symbols and formulae from the sheet of notes with no real plan of action or Uni-structural level similar to the Pre-structural level but now simple links are made between the question and required information essential to proceed to the solution.

“Clue- giving” scenarios

Here is a typical conversation exchange after the sheet has been checked and a student has had the opportunity to look and think. Not all of the questions are asked, but it will provide an idea of how the hint may be delivered.

Part a) worth one mark

“State the formula that you will use to calculate on which day she cycles 100 km”

Scenario One

Teacher: What situation is being described? Waits for students reply.
Student: Is it arithmetic?
Teacher: Why do you say that? What is your reasoning? Point to the part that helps?
If the student has some resemblance of the increase is constant, teacher confirms this

DEDUCTION One half of a mark

Scenario Two

Teacher: What situation is being described? Waits for students reply.
Student: I have no idea?
Teacher: What parts of the question do you know? Is the increase the same each time? Which value is the increase?

DEDUCTION One mark

Outcome for students

The students who had no idea have lost one mark, but now has a chance to complete the rest of the question as they have been pointed in the correct direction. Sometimes, students just have a complete blank about a question and so are given an opportunity to show the knowledge they actually know but nerves or anxiety is preventing.

The students who had an idea, but needed confirmation now can continue with confidence or are unsure, but show knowledge, such as it has a constant increase therefore it is Arithmetic Progression. Students now have another opportunity to show what they know even if they only get to the next step before needing more help.

3.3 Second type of clue

Students may require more than just a point in the correct direction but more direct and tangible information. Once again, the teacher will check the sheet of notes to see if the information is there and whether the student understands what is on the sheet of notes. This clue may involve identification and substitution of variables and/or more extensive algebra.

Question Requirement

Part b) involves recognition of the meaning of the letters in the formula from part a) and part c) the student has to realise that it is a sum that is required even though this is not explicitly stated.
Taxonomy Level

Bloom’s Cognitive level is where students can apply their knowledge to new situations, thus putting theory into practice so application of knowledge is present.

SOLO level is Multistructural is where a number of connections are made, but their relevance to each other and the pathway to the solution is not clear in the mind of the student.

“Clue-giving” scenarios

The student has completed part a) so this now would be a typical exchange for part b).

Part b) worth three marks

“To gain full marks, use the formula stated in part a) to calculate on which day she cycles 100 km.”

Scenario Three

Student: Not sure what to do next?

Teacher: Do you know what the variables are representing? Suggests looking at the sheet of notes. Writes the letters and asks the student to match the numerical values to the letters. Waits for students' attempt.

Student successfully identifies the variables without extra help.

DEDUCTION One mark

Scenario Four

Teacher: Do you know what the variables are representing? Suggests looking at the sheet. Writes the letters and asks the student to match the numerical values to the letters. Waits for students' attempt.

More explanation is required

Teacher: a is the first term and that value is 20, does that help identify the other letters?

DEDUCTION One and a half of marks

Scenario Five

The student has completed part a) and b) so this may be the next typical exchange for part c).

Part c) worth 4 marks

“Determine the total distance that she would have cycled from day 1 to day 14”

Teacher: What is the difference between parts b) and c)?

If students responds with sum and correctly identifies formula

DEDUCTION One mark

Scenario Six.

Teacher: What is the difference between parts b) and c)? What is this formula? What is the question asking for a term or a sum?

More explanation is required to reveal it is the sum rather than a nth individual term or perhaps requires a more detailed description and explanation of variables

DEDUCTION Two marks

Outcome for students

Students have shown they know many aspects of the question, but just cannot find the linking algebra or equation to find the route to the solution. This little extra piece of the puzzle gives students the chance to show the algebra skills required to finish the question. This would have been hidden as the bridge to get to this part was not available before the hint.

Having this real-time assistance shows the students exactly what area/aspect they need to improve and what information has worked or not worked on the sheet of notes.
4 DISCUSSION

Using “clue-giving” during tests has been a unique experience for both students and educators, and is still evolving, so there is no statistical evidence available for the effect on student learning as yet. The following are observations,

4.1 Students reluctance to ask for a clue

Some students would still prefer to leave a blank space rather than ask for a clue. Hence, receive no marks for the question. Students appeared to be worried about losing marks and could not see the potential gain of marks from asking for a clue. Tutors started to emphasise the positive aspect so talked about gaining marks when you get stuck on a point. The week before the test, at revision classes and just before the test, tutors gave examples of how students would only have the amount of marks allocated to the clue deducted but could continue with the possibility of now gaining the rest of the marks. Students had reminders during the test and would not be able to leave until they had attempted each question. Clues would be given here as students had been already willing to lose the full amount by not attempting the question.

4.2 Delivering the clues

Clues have to be tailored to suit each student, tutors need to use appropriate language, particularly with international students, mathematical terms are not essential. The test is not timed so there is no actual pressure if a few students raise hands at the same time. Gestures are as important as the response of student so there is some flexibility with the mark deduction.

The challenge for tutors is how to decide the initial level of the clue without stating something that the student knew but had not communicated, the problem then becomes how to apply a deduction. Teaching experience is a great aid here. When explaining the clue, the conversation with students will vary, which then requires a judgement call as to whether or not the deduction remains the same for each student.

4.3 Fairer assessment of a test

If students finds one question difficult, this may hinder the progress in the next question and then, students may lose confidence in their ability on all questions. The “clue-giving” may help students gain composure before attempting the rest of the questions. It is a source of frustration to students when they have content knowledge of the question but just no idea how to start the solution. The offer of a clue to start the question provides the conduit for the student to display the relevant content knowledge and extra marks that in the past would have been lost. One small step, stopping a route to a solution.

4.4 Learning moments

Instant feedback in a moment that may lead to marks within seconds is how some of the students view the clue-giving. The clarification the clue brings in the thinking moment, which hopefully will develop into a memory leading to a fuller understanding. Most will recall those after examination moments when you try to remember what your train of thought was for a question, but now muddled with all yours and other students’ thoughts and answers. Tutors will get a clearer insight into what concepts, words, and phrases block the pathway to the answer. Misconceptions can be brought to the surface, whereas in class, students often do not always elaborate on what their thoughts about the logic and method. Lecture material, tutorial questions and revision classes can incorporate these into class activities to provide better feedback to students when preparing the sheet of notes for tests.

5 CONCLUSION

Assessment is stressful for both educators and students, both have similar concerns, but from opposite points of focus. Educators wonder can my students do these questions is the difficulty level correct and students ponder on whether they can just do the questions to get some marks! It is difficult to convey how the “Clue-giving” operates in the written word as so much depends on gestures, tone of voice of the request for a hint, the emotional state of the student and so much more that happens under the surface. Finding any references to any other institutions at any level proved fruitless to the author and perhaps would have stumped the “little grey cells” of both Sherlock Holmes or Hercule
Poirot. The next step is to quantify how the “clue-giving” affects the overall mark for the unit and mathematical knowledge of the student.

REFERENCES
