Teaching Islamic
Geometric Patterns &
evaluation of My
Teaching Practice

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Teaching Islamic Geometric Patterns & Evaluation of My Teaching Practice

Introduction

This inquiry will look at how I can teach better through assessing my everyday practice in the classroom in terms of cycles, collecting appropriate data at each stage and evaluating my practice at the end. From this point of view, I will be examining the effectiveness of my own teaching and learning in the topic of “Islamic geometric patterns” through an action research.

I will begin by looking at the theories of teaching and learning to determine the best learning theory in teaching Islamic geometric patterns to my learners. This will be followed by a report on delivering and by reflective examination into the development of a new approach to teaching and learning of the subject.

Following this report, I will finally draw some conclusions with some of lessons learnt about teaching and learning Islamic patterns as a result of both the empirical and theoretical research.

The literature will help to explore to gain a better understanding of the current situation; will support the process of my research; and will suggest improvement in the areas that may need further changes in my practice.

Theories of Teaching and Learning

Learning is a lifelong commitment starts in the family and continues for all life. There are stages as well as differentiation and pace depends on the people’s intelligence and ability in learning. People learn in different ways which are described mainly by the three schools of learning namely the Cognitivist School, the Behaviourist and the Humanistic School. However, learning is a complex process and none of the theories of these schools provides us with the whole picture of learning.
Cognitive theory of learning argues that students learn when they construct their understanding, in other words they give meaning to what they are taught in their own words, taking their prior learning and experience into account. In this way, learning occurs, and students gain new experiences with the help of the previous ones-new learning is constructed from old-and gain ability to evaluate and use their learning in life. “This Cognitivist theory of learning is sometimes called ‘constructivist’, because it describes how learners construct their own knowledge” (Petty, 2004, p.7). The Bloom’s taxonomy describes the stages of learning clearly based on the theory of the Cognitivist. It is based on six stages namely knowledge, comprehension, application, analysis, synthesis and finally evaluation.

According to the taxonomy, students learn knowledge, can describe or explain it, and then can to apply it all of which do not require them to give full meanings. However, the last higher three stages require ‘thinking skills’ and more deep meanings to make. These are analysing-considering the parts separately, classifying and comparing, synthesis-creating hypothesis and new ideas-and evaluation that means making a judgement about mathematical solution for example in my case. Those who reach to that level of learning are able to check their own work, able to apply problem solving strategies in new problems, and also able to recognise their errors.

Second is the Behaviourist school’s theory which is based on rewards and motivation, and it was more relevant to my lessons in teaching Islamic geometric patterns. “The central tenet of behaviourism is that all motivation arises from basic drives, instinct or emotions in ways that are predictable” (Galloway, Rogers, Armstrong, Leo, Jackson, 1998, p.23). E. L. Thorndike (1874-1949) and Skinner (born 1904) are the two important behaviourists who worked on animals. They taught the animals by rewarding methods-rewarding with food when they did what were asked. The findings of their research apply to human learning and the principles of learning of this theory are based on four main approaches. These are reward-reinforcement-for learning, rewarding as soon as possible without any delay, step by step learning with the past success for the motivation and regular revision of the past learning. “Learning is more effective if it is motivated by a
It is also argued that competition for rewards promotes a surface approach to learning, and thus children expand their time and effort to maximise their rewards.

Finally, the last school of learning, the Humanistic school, believes that the highest values are emotional factors and personal development in learning. In this way, society and the educational establishments should respond to individual learners. “They believe that learners should be allowed to pursue their own interests and talents in order to develop themselves as fully as possible in their own unique direction” (Petty, 2004, p.16). For this adaptation is the most important factor in learning according to Jackson. He argues that students spend most of their time at the school and “we must recognise, in other words, that children are in school for a long time, that the settings in which they perform are highly uniform, and that they are there whether they want to be or not” (Jackson, P. W., 1968, p.4-11). In this way, the school argues that learners should be able to choose what they want to learn, should take responsibility for their learning, and should able to assess their own work.

**Action Inquiry into teaching Islamic geometric patterns**

With this action inquiry, my aim was to question the way I teach Islamic geometric patterns with focus on the factors such as assessment, resources, techniques, theory and lesson plan in order to maintain the quality standards in and establish a continual improvement of my teaching practice. To carry out my action inquiry I have used the action plan developed by Barret and Whitehead (1985): “What issue am I interested in researching?; why do I want to research this issue?; what kind of evidence can I gather to show?; why I am interested in this issue?; what can I do?; what will I do?; what kind of evidence can I gather to show that I am having an influence?; how can I explain that influence?; how can I ensure that any judgments I might make are reasonable, fair and accurate?; how will I change my practice in the light of my evaluation?”
I used the Lewin’s cycle of action inquiry which is based on identifying a general or initial idea and involves examining a real situation, identifying an area that needs correcting or improvement; reconnaissance or fact finding by which I investigated the effectiveness of my teaching in as many ways as possible. This includes observations and research of literature; I aimed to create planning after carefully defining the problem and carrying out fact-finding for observing and evaluating the outcome of changes made; I carried out the action plan in a real environment-through teaching 3 lessons-and carefully observed the results objectively without any judgment; evaluation by which I critically reflected on the success or failure of the action plan; I applied amended plan through which change has been implemented; and then the second action step has been taken and the process continued.

As it is argued that “the first step then is to examine the idea carefully in the light of the means available. Frequently more fact-finding about the situation is required. If this first period of planning is successful, two items emerge: namely, “an overall plan” of how to reach the objective and secondly, a decision in regard to the first step of action. Usually this planning has also somewhat modified the original idea” (Lewin, 1948, p.205).
My Teaching Cycles

I started my first teaching cycle with a short introduction to the topic. I discussed with the students what they already know and understand about geometrical patterns: I asked them to identify patterns that are used as symbols in their day-to-day life; I discussed with them the idea of repeating patterns as symbols and asked where they seen tessellating patterns in their daily life. I realised that a number of learners with Islamic background was aware of the Islamic geometric patterns as they visited Islamic buildings such as mosques and palaces. However, none of the learners was aware of the degree of Maths involved in creating such patterns in Islamic art.

Following this discussion, I began with an introduction to geometric patterns in Islamic art. I used various activities to reinforce geometric principles. I became thoroughly familiar with the materials before I used them with my students. I used the slides as a starting point (please see the appendix A). As my students viewed the visual materials, they became interested in the designs and curious about how
they were created. I explained the traditions of Islamic art to the learners. When viewing the slides, I called attention to the complex patterns used in the decoration of the objects. I let my students know that they would have the opportunity to create many of these patterns themselves.

I then asked the learners to identify various polygons by colouring as the first activity *(please see the appendix B)*. I wanted them to work individually. The lesson aim was to find out the learner's prior knowledge and skills in geometry and to build on these skills throughout the teaching cycles. When I planned my lesson I included some pattern-making activity following the pattern-identifying activity. However, I had to change my plan including the assessment strategy and teaching method during the lesson as discussed in the evaluation part of this inquiry.

**In the second cycle of teaching,** I led them through the pattern-making activities *(please see the appendix C)*. I asked the students to work in partners to practice setting up design, symmetry and colour scheme of their pattern. After they completed the activities, I returned to the slides for a more in-depth discussion of the patterns and effects of the designs. I helped them find patterns similar to the ones they created themselves. This second cycle finally ended with the evaluation of my teaching strategy and modifying the way what I learned from the previous cycle.

In the **third cycle,** I asked the learners to investigate methods for constructing Islamic tiling with straightedge and compass *(please see the appendix D)*. This involved only basic constructions of this type. I gave them step by step instruction to follow: first, concentric squares are drawn *(figure 1)* and a circle is constructed in the centre of the squares *(figure 2)*. A square is inscribed in the smaller circle and the lines extended to the large square *(figure 3)*. Lines are drawn connecting vertices of the inscribed square to midpoints of the large square *(figures 4 and 5)*. The circle is removed *(figure 6)*. The lines are widened the form the latticework *(figure 7)*. All intersecting lines are eliminated from the tile *(figure 8)*. The
overlapping detail of the tiles is created by alternating crossings of the latticework between over and under (figure 9).

The basic instruments for constructing geometric designs were a compass and ruler. Working only with a straightedge and a compass, the students discovered how to create many of the geometric shapes and patterns in the Islamic art. By creating patterns themselves students gained understanding of geometric principles of the underlying grids and methods used by Islamic artists.

Through the first cycle, I collected data by observation and using open-ended questions which was followed by the second and the last action of the cycle. I then evaluated my teaching method. Cohen et al (2000) and Robinson (2004) argue that the advantages of the open-ended questions include: the invitation of honest personal comment; the gathering of deeper information not available through a closed approach; obtaining authentic voices in response; they are useful when values are not known and how the respondent will respond is not assumed. In contrast, according to Robinson (2004) the response rate would like be low as the blank space is demanding and intimidating; analysis of the data requires considerable time and effort; it might be difficult the measure and clarify responses; and responses might be irrelevant as result of inadequate guidance from the instrument itself.

In my class observation, I watched and recorded the learners’ attitudes, expressions and approach to the session as notes which were turned into a detailed well described word documents at later stage. As a result, I planned another lesson for which I made some changes in my teaching method. I will discuss it further in details why I felt that changes were necessary in the following sections of my inquiry.

Mathematical norms of my model

I specifically focused on an open-ended Mathematics task-Islamic geometric patterns-as they would likely to create opportunities for the students’ personal
constructive activity. As Sullivan (1999) argues that the open-endedness allows a focus on key Mathematical issues and can be used to encourage students to investigate, make decisions, generalise, establish patterns and connections, communicate, and identify alternatives.

My model for planning and teaching consisted of certain norms: principles, generalizations, processes, mathematical tasks and solutions with the three aspects as Sullivan, Mousley and Zevenbergen (2002) state namely mathematical tasks and their sequencing; enabling prompts; and extending prompts. An important aspect of the tasks and their sequence is to create a notional sequence of tasks which is described by Simon (1995) as a learning path with its three components: a goal of aimed direction of teaching and learning; the activities carried out; and a hypothetical cognitive process. Because, “a prediction of how the students’ thinking and understanding will evolve in the context of the learning activities” (Simon, 1995, p.136).

The second aspect enabling prompts was mainly used to encourage the students who experienced difficulty to engage in other tasks related to the main task, rather than providing further explanations for how to solve it or pursue them separately from the rest of the class. In this way, the students who struggled were to be diverted to the other easier tasks giving them opportunity to rejoin the class learning path consequently, keeping them up with their peers. Wood (2002) argues that all students benefit from participation in main mathematical tasks and social experiences, and that rich social interactions with others contribute substantially to pupils’ opportunities for learning mathematics.

Then lastly, with the extending prompts those who completed their classroom tasks were to be given extra activities (please see the appendix E) encouraging them to extend their comprehension on those tasks: with the purpose of creating opportunities for extension of Mathematical thinking on open-ended tasks while the students could explore various options and consider forms of generalised response.
EVALUATION TEACHING AND LEARNING

What is and why evaluate?

In this part of the essay, I will further evaluate my teaching practice and will make suggestions for improvement. Evaluation is systematic inquiry designed to provide information to those who are interested in a particular programme. The primary focus of evaluation is to determine the effectiveness of a programme in light of the attainment of set priorities and goals. It identifies weaknesses, strengths, and the areas that need revision or the possible cessation of the programme. “So evaluation becomes a key component of a cycle: identify learners’ needs, abilities and desires, create and deliver learning programmes, assess learning, evaluate the reflections ready for your next programme.” (Hillier, 2003, p.245).

Evaluation of the effectiveness of my teaching

Following the implementation of the cycles in my practice my findings showed that the Cognitive teaching theory did not work in teaching Islamic geometric patterns to my learners.

When I asked the learners to identify the polygons such as parallelogram and rhombus by colouring in order to check their understanding most students failed. This showed that they lack of knowledge in geometry. They were not able to construct their understanding on their skills and knowledge through identifying the geometrical shapes. Their answers to my open-ended questions determined that they struggled with most of the geometrical patterns and tessellating them. They also stated that they found difficult to draw repeated patterns without looking at Islamic geometric pattern samples.

However, when they worked together in the second teaching cycle, a higher number of students managed drawing the patterns using a circle with helps from their friends in the groups. They were also allowed to look at the patterns samples
in my second teaching cycle. This also showed that my assessment strategy did not work too in the first cycle.

**How can I best plan and prepare learning sessions for my students?**

I used the materials namely whiteboard, handouts, pen & notebook and compass, ruler, and power point presentation in my lessons. I especially chose these resources after the second cycle as because my lesson needed to be based on the theory of behaviourism and these became the necessary tools. “Maths is learned by doing maths-not watching someone else do it” (Brown et al, 1995, p.76). In my lessons, ‘practice’ became the key word and the learners need supportive materials for it. For example while whiteboard gave a chance my students to practice their drawings, handouts helped them to revise the previous lessons by practising the same activities.

I believe that I used them successfully in the second and third cycles of my practice as my students found an opportunity to practise the patterns by repeating as many times as they wished.

**What are the most effective teaching techniques with my students?**

From this point of view, in the first teaching cycle, I planned my lesson using Cognitive theory of learning in my teaching session and taught it according to this new strategy. The aim was to find out how this method was appropriate for the learners. My expectation from the lesson was that the students would able to construct their understanding and build on their existing skills and knowledge in Maths. I assessed their understanding by asking questions individually (*please see the appendix B*).

Because, in this way, I expected them to explain the Maths used in drawing Islamic patterns in their own words other than the way in which I told them. Thus, I wanted to find out how well the lesson was understood and whether skills, and previous knowledge of the learners were applied. This is learning with understanding which
is thus met with the Cognitivist school theory. “The Cognitivist school believes that learning by doing, and asking students challenging questions, will help students make their own sense of what they are studying and enable them to make use of their learning in real life” (Petty, 2004, p.4). Whereas the Cognitivist theory argues that learners should be able to explain what they learned in terms of other concepts, successful learning is a result of personal hypothesis-making, and “only when learners have ‘made sense’ of the topic …will they be able to reason with it to solve problems and to do other useful task” (Petty, 2004, p.7).

What I found that the students did not cope with Cognitivist teaching method as when they were asked to identify the polygons by colouring them. They could not identify all the polygons.

As a result, I have replaced the cognitive learning theory with behavioural theory in the second cycle of my research, based on repetition and reinforcement. “The central tenet of behaviourism is that all motivation arises from basic drives, instinct or emotions in ways that are predictable” (Galloway, Rogers, Armstrong, Leo, Jackson, 1998, p.23). “Learning is more effective if it is motivated by a desire to succeed rather than by a fear of failure” (Petty, 2004, p.19-20). It is also argued that competition for rewards promotes a surface approach to learning, and thus children expand their time and effort to maximise their rewards.

Repetition is the key point of the Behaviourist theory which I started using it in my practice after the first teaching cycle, whereas I could not realise its potential benefit in my first teaching cycle: this element of the Behaviourist theory ends with a disaster if ignored or not applied professionally. I believe this change in my practice, in order to improve my practice, enhanced the effectiveness of my teaching further. My aim thus was to summarise the lesson at the very beginning and at the end of my lesson and refer what I taught again and again during it. This was also be followed regularly revising the previous lessons with practical pattern-making activities. Because “we remember what we have experienced frequently and recently” (Petty, 2004, p.16).
Secondly, in the first cycle, during my observation, I became conscious that my students lost their motivation after 30 minutes. After this critical incident, I was confused and did not know how to deal with the situation. I asked myself did I use positive reinforcement of students during the lesson? How did I indicate to students that they were making process? I realised that I did not praise them during the pattern-making activities. As Eraut (1994) stated “when time is extremely short, decisions have to be rapid and the scope of reflection is extremely limited” (p.145) I thought different prospective to clarify the problem and had to take a quick decision; because “(…) practical problems can be simply dealt with if we apply our scientific principles to finding the solution” (Hillier, 2003, p.17). I had to tell them that they were making progress each time after they created a new Islamic geometric pattern. I therefore planned, to apply in the second cycle, to praise my learners for their work. Having gone through this process of reflection on my own professional practice, I praised them straight away for their drawings; thus my students were more actively engaged the lesson and showed more effort in this second lesson. As Boud et al (1985) defined reflection as an important human activity in which I recaptured my experience, thought about it, mulled it over and evaluated it.

In terms of assessment, Boud (1995) argues that good assessment should assess students’ range of abilities including problem solving, critical thinking, effective communication and working in groups.

I allowed the students to use the whiteboard for their drawings. They were comfortable with using it. As Black et al (1998) state that effective learning is an activity in which “students have to be actively involved” (p.5) all my students were interested in using the board except few. In this way, I monitored the progress which was prove that they have learned better as they showed kinaesthetic learner characteristics; Kinesthetic learners are those who learn through doing things.
Conclusion

In this essay, I focused on my own teaching and learning in order to find out the effectiveness of my teaching practice, my own needs accordingly and to develop of a new approach to teaching and learning of my subject.

Starting with an introduction to Islamic geometric patterns, my lessons covered the practical ruler and compass construction of a fundamental geometric pattern used throughout the Muslim world. Geometric considerations and some possible symbolic interpretations were covered while teaching. At the end of the teaching cycles, the learners were excited with the skills and knowledge gained in the Islamic geometric patterns.

Firstly, I discussed learning by taking the three school theories’ approaches in learning into my consideration. Whilst the Cognitive School’s theory of learning is highly accepted, as well as valued, and it was my espoused theory at first, I realised that it did not work in my practice.

I thoughtfully and critically examined my own teaching. I aimed to understand the problem appeared through a professional analysis. After carefully reflection on my teaching cycles, I have found out that my students were reluctant to comprehend Maths. My espoused theory-Cognitivist- was not suitable for the learners, Thus, I tried to decide the best method of teaching for the benefit of my student: Behaviourist theory was the most suitable in this case.

In order to improve the quality of learning, I will start displaying the students’ work in the classroom to improve their motivation. I will need to start listening what my students comment on their learning beside the observation; this is an easy method to use in each session that can be formal or informal listening. Bruce et al (2000) support the idea of listening to learn saying, “Teaching by listening showed how children were able to engage more deeply in the process of mathematical thinking when they were encouraged to articulate their own ideas and not just listen to the teacher. Through this telling, the children often revealed aspects of thinking about the teaching that could provide invaluable guidance to the teacher” (p.256).
References

Barret, J. Whitehead, J. (1985), *Supporting teachers in their classroom research*, University of Bath, School of Education.


Appendixes

Appendix A

Islamic Patterns

Pattern Examples

Fez, Morocco, 1325

Isfahan, Iran, end of 10th century

Interior Dome of the Rock, Jerusalem, 7th C

Islamic Patterns

Regular and Semiregular Tilings
Islamic Patterns

Most of the famous patterns in the Alhambra in Granada are based on squares, octagons, equilateral triangles and hexagons.

Arabesque-style decoration is characterised by stylised twisting plant-like designs.

(Figure 35)
Appendix B

The pattern-identifying activity (first cycle)

First activity: look at this section of an Islamic pattern

Identify these polygons by colouring:

A parallelogram, colour it green
A rhombus, colour it red
A square, colour it blue
A trapezium, colour it yellow
A rectangle, colour it brown
A regular hexagon, colour it red
An irregular hexagon with two lines of symmetry, colour it blue
An irregular hexagon with one line of symmetry, colour it blue
A pentagon with one line of symmetry, colour it green
An equilateral triangle, colour it yellow.
Second activity: Creating from one circle to five overlapping circles

Step-by-step activity:

- Bisect the page by drawing one horizontal and one perpendicular line. Mark the centre as A.

- Place the compass point at point A and draw a circle. Leave room to draw equal sized circles on each side, at the bottom, and at the top. Mark the points that cross the lines B, C, D and E.
Using points B, C, D and E, draw four more circles. Mark the points where the four circles intersect, F, G, H, and J.

Use a straightedge to draw the lines FH and JG through the centre. These lines intersect the original circle at four equally spaced points at K, L, M, and P.

The straight lines both divide the circle into eight equal parts and locate eight equally spaced points- B, C, D, E, K, L, M, P – on the circumference of the original circle. This is the result of the five circles having the same radius.
Appendix C

The pattern-making activity (second cycle)

1- Draw a circle with a compass.

2- Without changing the opening (radius) on the compass, draw another circle whose centre is on the rim of the first circle.

3- If you connect the centres and one of the points where the circles cross, you get an equilateral triangle.

Why do all the sides have the same length?

4- Again without changing the radius, draw another circle whose centre is one of the intersection points.

5- Keep drawing new circles at the new intersection points.
What could a circle mean to you as a symbol?

Does this design have rotation symmetry? By what angles?

Does this design have reflection symmetry? Across what lines?

6- Keep drawing more circles at the intersection points until you have a pattern that covers most of the page.

What kinds of symmetry does this pattern have, assuming it goes on forever?

7- Can you find the pattern of triangles in the circle pattern? You will have to imagine or draw in the lines.
Appendix D

The pattern-making activity (third cycle)

Figure 1: Centred Squares    Figure 2: Centred Circle    Figure 3: Perpendiculars
Figure 4: Spokes    Figure 5: Star Pattern    Figure 6: Circle Removed
Figure 7: Paths Drawn    Figure 8: Lattice Refined    Figure 9: Overlapping
Appendix E

Extra activity

How are the stars growing?
Investigate this and find a rule to explain this growth.
Find the area of first start and use your rule to predict the area of the other stars in the sequence:
What would be the area of the 5th star, the 10th star in the sequence?