CREATING ISLAMIC ART WITH INTERACTIVE GEOMETRY SOFTWARE

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ABSTRACT

The production of images, in particular figurative art is discouraged in Islam on the basis that it could lead to idolatry. For the Muslims there is no divinity other than the Almighty God and this means that no any form of creations can be projected to His attributes. In this way, muslim artists express their works in creating patterns of complex geometric designs as well as intricate patterns of vegetative ornament. These masterpieces have covered the surfaces of buildings especially mosques, palaces and other public places in replace to human figures as established in the non-Muslim culture. From the mathematical perspective, the distinctive Islamic art has cleverly combined the use of common geometric shapes such as circles, points and lines together with some geometric principles such as symmetry, similarity and transformation, namely translation, rotation, reflection and scaling. With the present software technology, the creation of this art can be made easier using interactive geometry software (IGS) which is also known as dynamic geometry software (DGS). IGS are computer programs which allow their users to interactively create, manipulate and explore geometric constructions using points, lines, circles and geometric principles. Activities involving students to create Islamic art with IGS will help them to appreciate mathematics as an art that is enjoyable and fun besides realizing that its development is greatly influenced by values and cultures. This paper will describe how some basic designs can be constructed using KDE interactive geometry (KIG) which is available as free open source software (FOSS). Some samples of creative students' work will also be shared.

INTRODUCTION

Ethnomathematics is a study concerning mathematical activities in society involving human activities around us outside the mathematics classrooms. Understanding ethnomathematics make us realize that mathematical activities evolve around values and beliefs. One prominent way of investigating mathematics and culture is through historical approach. History of mathematics have portrayed the development of mathematics around the world in different civilizations. Originally much historical research are limited to western culture but now much work are carried out to study the non-European culture in the East and West..

Work on cultural history of the Muslim world revealed that the Muslims have significantly contributed in the development of mathematics. Unlike the Westerners, the Muslim seemed to be more opened to accept mathematical ideas right from the early development of mathematics. The Western societty with their orthodox views were quite resistant to new mathematical practices as reported in many incidents. One bad incident was the assassination of the Greco-Egyptian mathematician Hypatia who was alleged for teaching about the roundness of the earth at a time when Christian leaders wanted to revive the notion of a flat earth. During the late Middle Ages many Westerners rejected the very notion of a zero, regarding it as a creation of Satan. Some argued that zero can lead to dishonest transactions as the symbol zero can be easily changed to number six or nine.

On the other hand, Islam encourage both the study of physical and spiritual knowledge as both complement each other towards understanding reality. In fact, from Islamic perspective

the scientific and mathematical study of the real world will strengthen one's religious faith. The mathematical properties, patterns and algorithms all manifest the creations of God the Almighty with His precise law and order.

The mathematics embedded in Islamic culture are not widely aware by many mathematics educators both Muslims and non-Muslims. In fact, the mathematical activitis that have rooted during the early Islamic age still continue to be practised in today modern society. Since Islamic teachings are absolute truth as well as complete guide, Muslims lead their life according to them regardless of time and locations. Thus Islam is manifested in all walk of lives including economy, politics, education and social welfare.

Geometrical designs are rampantly manifested in the Islamic architecture, in particular in mosques and public buildings. Because many Islamic scholars disapprove the artistic representation of humans and animalls, Islamic art has been evolved around geometrical designs and calligraphy. The ancient designs have survived several centuries in monuments like Taj Mahal in India and Alhambra in Spain. The work on this line of designs are still carried out by contemporary designers especially in interior and on the exterior surfaces of mosques, carpet designs and pages of the Holy Quran. Obviously, geometry is a branch of mathematics that are widely applied and appreciated in the Muslim world which also has been spread out in the art of European designers. Since mathematics is a human activity, logically it should be taught emphasizing on the human activities surrounding the mathematical knowledge.

GEOMETRICAL THINKING

Traditional school geometry curriculumn focus on the learning of definitions and properties of shapes. This focus is not relevant to learning. Instead of memorizing properties and definitions, students should develop personally meaningful geometric concepts and ways of reasoning that enable them to carefully analyze spatial problems and solutions. Currently, the best description of students' thinking about plane geometry is the van Hiele theory of geometric thinking. The Van Hiele levels of geometric reasoning are sequential. Students must pass through all prior levels to arrive at any specific level. These levels are not age-dependent in the way Piaget described development. Geometric experiences have the greatest influence on advancement through the levels. Instruction and language at a level higher than the level of the student may inhibit learning.

The first level of Van Hiele level of geometric thinking is visualization. At this level, students can name and recognize shapes by their appearance, but cannot specifically identify properties of shapes. Although they may be able to recognize characteristics, they do not use them for recognition and sorting.

The second stage; analysis, students begin to identify properties of shapes and learn to use appropriate vocabulary related to properties, but do not make connections between different shapes and their properties. Irrelevant features, such as size or orientation, become less important, as students are able to focus on all shapes within a class. They are able to think about what properties make a rectangle. Students at this level are able to begin to talk about the relationship between shapes and their properties.

At the third level, the informal deduction level, students are able to recognize relationships between and among properties of shapes or classes of shapes and are able to follow logical arguments using such properties.

The fourth level in the van Hiele theory is deduction. At this level, students can go beyond just identifying characteristics of shapes and are able to construct proofs using postulates or axioms and definitions. Rigor is the highest level of thought in the van Hiele hierarchy. Students at this level can work in different geometric or axiomatic systems and would most likely be enrolled in a tertiary level course in geometry.

Many secondary school students are expected to achieve at Level 3. With proper support they may reach up to level 5. The levels of geometric thinking can be achieved if students. gain experience working with geometrical objects in a computer based environment

(Mahyuddin Abdullah, 2007). Specifically, interactive computer geometry can be a useful tool to provide students with the opportunity to investigate, to build and take apart, to create and make drawings, and to make observations about shapes in the world around them.

THE ROLE OF INTERACTIVE GEOMETRICAL SOFTWARE

Interactive geometrical software was introduced since 1986. *Geometer's Sketchpad* (GSP) was one of the early kind. KIG is another model of interactive geometrical software with some similar capabilities to those of GSP. KIG which runs on linux operating system is an open source software. The KIG window as presented in Figure 1 has a main menu with seven submenu. Users can make constructions by clicking on the menu or the objects displayed on the right and left of the window.This tool does not only help learners to create geometrical constructions using lines, lines and polygons, but it also allow them to manipulate the constructions by dragging and moving points, lines and objects..

Interactive geometrical software can make learning geometry meaningful compare to the static objects drawn on paper. Some misconceptions can also be corrected in this kind of learning environment. The graphic and numerical capabilities of computers provide a rich new mathematical enviroment in which geometry students can experiment with shapes and relations. This exploratory experience offers promise of building strong geometric intuition and conjecturing spirit that is essential for problem solving and theory building in any branch of mathematics.

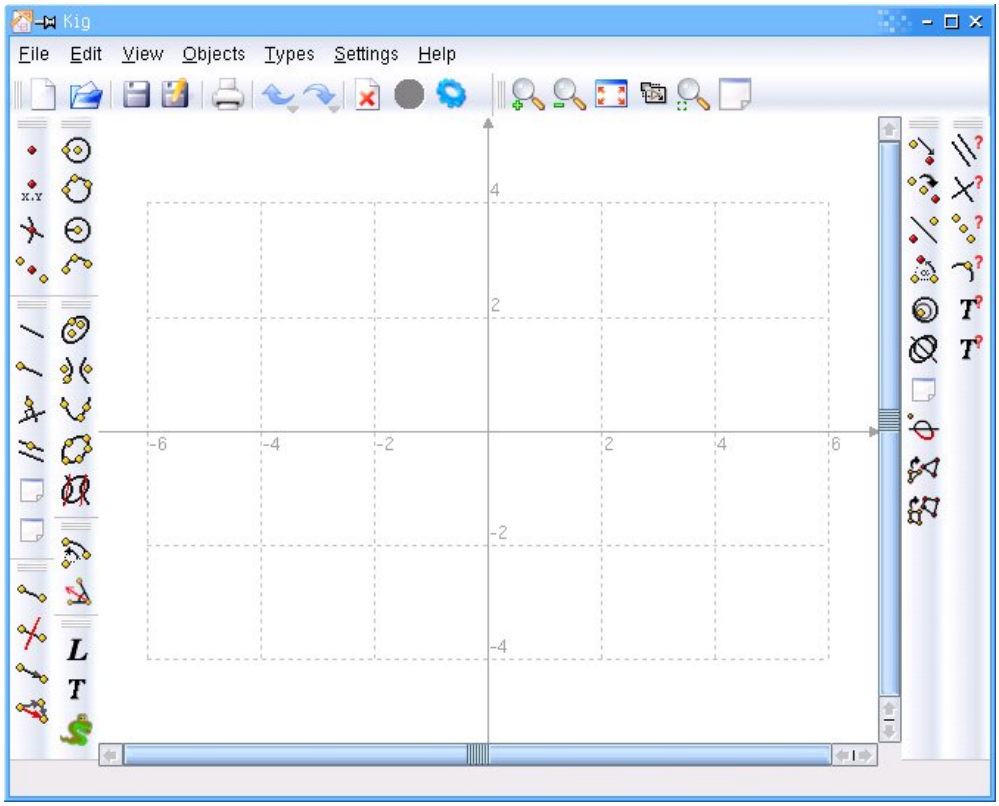

Figure 1: KIG window

Working manually with paper, pencil, ruler and a compass, to construct Islamic geometry will demand tedious and time consuming drawings of various geometrical objects at different locations and arrangements. On the other hand, using interactive geometry software better, precise drawings can be produced in a very short time. Even though this is so, with this useful tool, students experience working with geometrical shapes and important geometrical concepts in particular similarities, congruenct, transformations are not being jeopardized. In fact, learners can see the concepts better as they witness the changes of the constructions as they manipulate lines, points angles and objects.

Take a look at the simple motif in Figure 2 which consists of seven circles at different positions (Saifulnizam Che Ismail, 2007). To construct the motif, the red circle of selected size and centre positioned at the origin of the xy coordinates. Next by translating the red circle along a vector of two units on the x-axis to the right, a new blue circle is formed. To create the six petals in the red circle, simply produced repeatedly by rotating at 60degrees for the circle with centre of rotation at the origin.

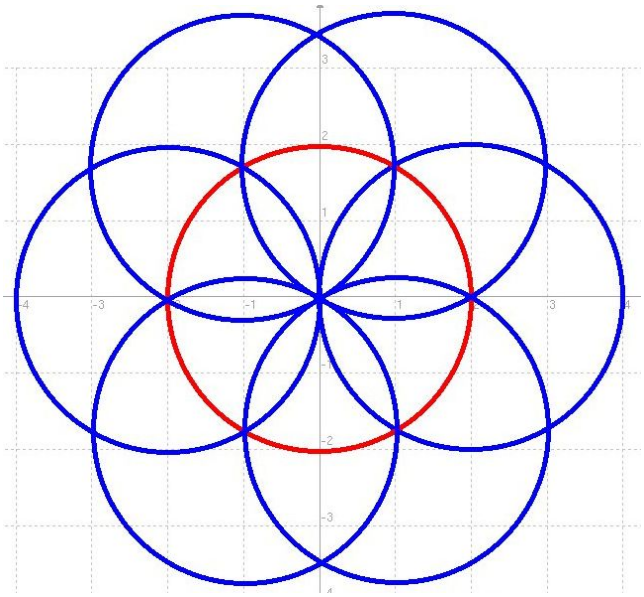

Figure 2: Simple motif

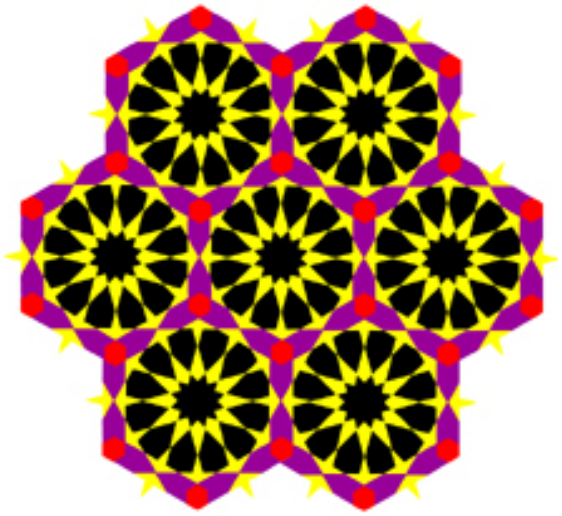

Figure 3: Sample motif that can be created using KIG

Figure 3 is another example of a motif that can be created using KIG. Working with inservice primary school teachers, surprisingly they are quite creative. They were requested to create Islamic art using KIG together with instructions on how to make them. Figure 4 and 5 are two selected samples of their work. The motif in Figure 4 are constructed using eight steps as described below the way it was written by a student. The instructions show that the motif was basically created by drawing a circle follow with repeatedly draw polygons of different number of sides. . The students claimed that the design is a symbolic for Malaysia with her 14 states.

Instructions:
1. Choose circle by center.
2. Click objects then choose polygon and select regular polygon with given center.
3. Construct a regular polygons vertex.
4. Then adjust the number of side until it turn to (14/4).
5. Repeat the step 2,3,and 4 and then adjust the number of side until it turn to (101/50).
6. To change the color, select each of the point, right click and select color-green.(for side 14/4)
7. Repeat step 6 to color side (101/50) with blue color.
8. Repeat step 6 again to adjust the width of the circle by right click,
choose set pen width then choose third width and choose black color.

Symbolic of the symbol:
There are 14 side which mean 14 of state in Malaysia.
The side (101/50) mean the luxury,cheerful,harmony and lovely citizens.
The big circle mean the powerful of Malaysia as Islamic country
and have a cooperative citizen although we have multiracial citizens.

Figure 5 was created using the given instructions.

Instructions :
***Centre Star*
1) Select object, then click the polygon to choose the regular polygon with given center.
2) Adjust the star size to cordinat of (0,0).
3) Choose the color of the star.

Side Star
1) Select object, then click the polygon to choose the equilateral triangle.
2) Adjust the star size to cordinat of (-100,0). Then we translate the star to a line to get the

translation image.
3) Choose the color of the side star.

Line Border

1) *Select line tool to draw a line from one end to one end.*

2) *Apply to all section.*

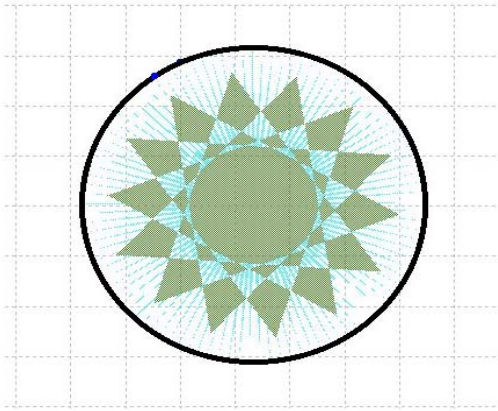

Figure 4

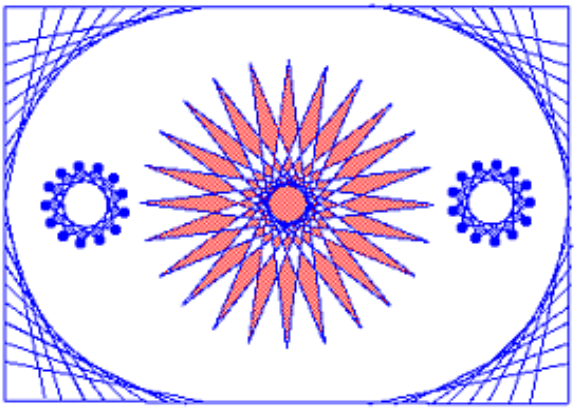

Figure 5

CONCLUSION

The task of creating Islamic art using interactive geometrical software teach students to appreciate the beauty of mathematics. Secondly, they also realize that mathematics and culture cannot be separated.Thirdly, they can see geometrical ideas from a richer perspective exploring and experimenting new ideas to discover mathematical properties, patterns and relations. Other than that, and most important of all as many research shows, working in interactive geometric environment can help them to achieve various levels of geometric thinking.

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