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ORIGINAL LITERARY WORK DECLARATION

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Field of Study: Mathematics Education

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SYNOPSIS

The purpose of this study was to investigate preservice secondary school mathematics teachers (PSSMTs)' subject matter knowledge (SMK) of perimeter and area. Specifically, this study aimed to investigate PSSMTs’ five basic types of knowledge of perimeter and area, namely conceptual knowledge (CK), procedural knowledge (PK), linguistic knowledge (LK), strategic knowledge (SK), and ethical knowledge (EK). This study also aimed to investigate PSSMTs' levels (low, medium, high) of SMK of perimeter and area.

Data of this study was collected using clinical interview technique. Interview sessions were recorded using digital video camera and tape recorder. Subjects of this study consisted of eight PSSMTs enrolled in a Mathematics Teaching Methods course at a public university in Peninsula Malaysia. They were selected based on their majors (mathematics, biology, chemistry, physics) and minors (mathematics, biology, chemistry, physics).

With regard to CK, findings of this study showed that all PSSMTs understand the inverse proportion between the number of units and the unit of measure. Six out of eight PSSMTs knew the relationship between area units and linear units of measurement that area units are derived from linear units based on squaring. Nevertheless, most of the PSSMTs did not know that there is no direct relationship between perimeter and area. None of the PSSMTs were able to develop the formula for the area of a rectangle. It was apparent that all of them lack conceptual knowledge underpinning the formula for the area of a rectangle.

With respect to PK, findings of this study depicted that at least half of the PSSMTs had adequate procedural knowledge of converting standard units of area measurement. Most of the PSSMTs had adequate procedural knowledge of calculating perimeter and area of composite figures. Five, two, and three PSSMTs were able to develop the formula for the area of a parallelogram, triangle, and trapezium, respectively.
Concerning the LK, findings of this study demonstrated that most of the PSSMTs used appropriate mathematical symbols to write the formula for the area of a rectangle, parallelogram, triangle, and trapezium. Most of the PSSMTs used appropriate mathematical terms to justify their selection of shapes that have a perimeter and an area. All the PSSMTs understand the general measurement convention that perimeter is measured in linear units while area is measured in square units. Nevertheless, they had limited knowledge about the conventions pertaining to writing and reading of Standard International (SI) area measurement units.

For the SK, findings of this study revealed that three types of strategies were employed by the PSSMTs to compare perimeters as well as areas, namely formal, semi-formal, and informal methods. Two types of strategies used to verify the answers for perimeters and areas were emerged, namely recalculating strategy and alternative method. Three types of strategies used to solve the fencing problem were identified, namely looking for a pattern strategy, trial-and-error strategy, and differentiation method. PSSMTs used the cut and paste strategy, partition strategy, and algebraic method to develop the formula for the area of a parallelogram, triangle, and trapezium, respectively.

With respect to EK, findings of this study exhibited that all PSSMTs had taken the effort to justify the selection of shapes that have a perimeter and an area. Several PSSMTs had attempted to examine the possible pattern of the relationship between perimeter and area, to formulate and test generalization pertaining to the relationship between perimeter and area. However, most of the PSSMTs did not check the correctness of the answers for the perimeters and areas. With regard to the overall level of SMK of perimeter and area, only one of the PSSMTs secured a high level of knowledge, six with medium level and one at low level. The findings of this study lead to the conclusion that many PSSMTs do in fact lack SMK of perimeter and area they are expected to teach.
PENGETAHUAN ISI KANDUNGAN GURU PRAPERKHIDMATAN MATEMATIK SEKOLAH MENENGAH BAGI PERIMETER DAN LUAS

SINOPSIS

Kajian ini bertujuan untuk menyelidiki pengetahuan isi kandungan (PIK) guru praperkhidmatan matematik sekolah menengah (GPMSM) bagi perimeter dan luas. Secara khusus, kajian ini bertujuan untuk menyelidiki lima jenis pengetahuan asas bagi perimeter dan luas yang dimiliki oleh GPMSM, iaitu pengetahuan konsep (PK), pengetahuan prosedur (PP), pengetahuan linguistik (PL), pengetahuan strategik (PS), dan pengetahuan etika (PE). Kajian ini juga bertujuan untuk menyelidiki peringkat (rendah, sederhana, tinggi) PIK yang dimiliki oleh GPMSM.


Berhubung dengan PK, dapatan kajian ini menunjukkan semua GPMSM memahami perkadaran songsang antara bilangan unit dan unit pengukuran. Enam daripada lapan GPMSM mengetahui hubungan antara unit luas dan unit linear di mana unit luas diterbitkan daripada unit linear berasaskan kuasa dua. Walau bagaimanapun, kebanyakan GPMSM tidak mengetahui bahawa tiada hubungan langsung antara perimeter dan luas. Tiada GPMSM yang dapat menerbitkan rumus bagi luas segiempat tepat. Ini menunjukkan kesemua mereka kekurangan PK di sebalik rumus bagi luas segiempat tepat.

Berkenaan dengan PP, hasil kajian ini menunjukkan sekurang-kurangnya separuh daripada GPMSM mempunyai pengetahuan yang mencukupi untuk menukar unit piawai...
ukuran luas. Kebanyakan GPMSM mempunyai pengetahuan yang mencukupi untuk menghitung perimeter dan luas rajah gubahan. Lima, dua, dan tiga orang GPMSM masing-masing dapat menerbitkan rumus bagi luas segiempat selari, segitiga, dan trapezium.

Berkenaan dengan PL, dapatan kajian ini menunjukkan kebanyakan GPMSM menggunakan symbol matematik yang sesuai untuk menulis rumus bagi luas segiempat tepat, segiempat selari, segitiga, dan trapezium. Kebanyakan GPMSM menggunakan istilah matematik yang sesuai untuk memberikan justifikasi ke atas pemilihan bentuk-bentuk yang mempunyai perimeter dan luas. Kesemua GPMSM memahami kelaziman am pengukuran di mana perimeter dan luas masing-masing diukur dalam unit linear dan unit persegi. Walau bagaimanapun, mereka mempunyai pengtahuan yang terhad tentang kelaziman penulisan dan pembacaan unit luas Sistem Antarabangsa.

Berkenaan dengan PS, hasil kajian ini menunjukkan tiga jenis strategi telah digunakan oleh GPMSM untuk membandingkan perimeter dan juga luas, iaitu kaedah formal, semi-formal, dan informal. Dua jenis strategi yang digunakan untuk menyemak jawapan bagi perimeter dan luas telah muncul, iaitu strategi penghitungan semula dan kaedah alternatif. Tiga jenis strategi yang digunakan untuk menyelesaikan masalah berpanggar telah dikenal pasti, iaitu strategi mencari pola, strategi cuba-jaya, dan kaedah pembezaan. GPMSM menggunakan strategi “potong dan tampal”, strategi pembahagian, dan kaedah algebra masing-masing untuk menerbitkan rumus bagi luas segiempat selari, segitiga, dan trapezium.

Berkenaan dengan PE, dapatan kajian ini menunjukkan semua GPMSM telah berusaha untuk member justifikasi ke atas pemilihan bentuk-bentuk yang mempunyai perimeter dan luas. Beberapa orang GPMSM telah mencuba untuk meneliti pola hubungan yang mungkin antara perimeter dan luas, membentuk dan menguji pengitlakan yang berkenaan dengan hubungan antara perimeter dan luas. Namun begitu, kebanyakan GPMSM tidak menyemak jawapan bagi
perimeter dan luas. Pada keseluruhannya, hanya seorang GPMSM mencapai peringkat tinggi untuk PIK bagi perimeter dan luas, enam orang dengan peringkat sederhana dan seorang pada peringkat rendah. Dapatan kajian ini menunjukkan ramai GPMSM kekurangan PIK bagi perimeter dan luas yang akan diajar.
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Beng converts 1.25 km² to m²

Beng draws two squares and labels them as A and B respectively

Beng calculates the perimeters and area of trapezium and rectangle that she has drawn

Beng labels the missing sides of Diagram 1

Beng calculates the perimeter of Diagram 1

Beng calculates the area of Diagram 1

Beng uses alternative method to calculate the area of Diagram 1

Beng labels the missing sides of Diagram 2

Beng calculates the perimeter of Diagram 2

Beng calculates the area of Diagram 2

Beng calculates the area of Diagram 2

Beng uses looking for a pattern strategy to solve the fencing problem

Beng draws the pattern of the area values

Beng draws the fence with the shortest length (2 m) and the longest width (41 m)

Beng draws a rectangle and writes its area formula

Beng draws a parallelogram and writes its area formula

Beng develops the formula for the area of a parallelogram

Beng draws a triangle and writes its area formula

Beng draws a trapezium and writes its area formula

Beng develops the formula for the area of a trapezium

Liana’s selection of shapes that have a perimeter

Liana’s selection of shapes that have an area

Liana measures the length of the top, the bottom, and the left sides of the T-shape by ruler and then calculates its perimeter

Liana measures the length and the width of the rectangle by ruler and then calculates its perimeter

Liana measures the length and the width of each rectangle by ruler and then calculates its area

Liana measures the length of two adjacent sides of the square by ruler and then calculates its area

Liana repartitions the L-shape into two rectangles and then calculates its area

Liana writes 16 cm² and 13 cm² in English words

Liana converts 3 cm² to mm²

Liana draws a diagram to illustrate the conversion from cm² to mm²

Liana converts 4.7 m² to cm²

Liana converts 1.25 km² to m²

Liana draws two triangles and then calculates its area respectively

Liana draws two circles and then writes the formula for the circumference and area respectively

Liana labels the missing sides of Diagram 1

Liana calculates the perimeter and the area of Diagram 1

Liana uses alternative method to calculate the area of Diagram 1

Liana labels the missing sides of Diagram 2

Liana calculates the length of MI, also labels as “a”

Liana calculates the perimeter of Diagram 2

Liana calculates the area of Diagram 2

Liana suggests alternative method to calculate the area of Diagram 2

Liana draws a diagram to represents the fencing of the rectangular garden

xxx
Lina writes an equation to represent the perimeter and area of the rectangular garden respectively.

Liana draws a rectangle and then writes its area formula.

Liana draws a parallelogram and writes its area formula.

Liana writes the area formula of a triangle.

Liana develops the formula for the area of a triangle.

Mazlan’s selection of shapes that have a perimeter.

Mazlan’s selection of shapes that have an area.

Mazlan draws a square, rectangle, and triangle and writes its respective area formula and unit.

Mazlan draws a square and then partitions it into two triangles.

Mazlan measures the length of each side by ruler and then calculates its perimeter respectively.

Mazlan measures the length of each side by ruler and then calculates its area.

Mazlan measures the length of two adjacent sides by ruler and then calculates its area.

Mazlan writes 16 cm$^2$ and 13 cm$^2$ in English words.

Mazlan converts 3 cm$^2$ to mm$^2$.

Mazlan converts 4.7 m$^2$ to cm$^2$.

Mazlan converts 1.25 km$^2$ to m$^2$.

Mazlan draws diagrams to show that the thread can be rearranged to form other shapes such as triangle, square, or circle besides rectangle.

Mazlan labels the missing sides of Diagram 1.

Mazlan calculates the perimeter and the area of Diagram 1.

Mazlan labels some of the missing sides of Diagram 2.

Mazlan calculates the perimeter and area of Diagram 2.

Mazlan uses alternative method to calculate the area of trapezium FIJK.

Mazlan uses trial and error strategy to solve the fencing problem.

Mazlan draws another rectangle and then calculates its area.

Mazlan draws a rectangle and writes its area formula.

Mazlan draws a parallelogram and writes its area formula.

Mazlan draws two triangles and writes its area formula.

Mazlan draws a trapezium and writes its area formula.

Mazlan tries to develop the formula for the area of a trapezium.

Patrick’s selection of shapes that have a perimeter.

Patrick’s selection of shapes that have an area.

Patrick draws a large rectangle and then calculates its area.

Patrick measures the length of each side of the T-shape and rectangle by ruler and then calculates its perimeter respectively.

Patrick calculates the perimeter of the T-shape.

Patrick calculates the perimeter of the rectangle.

Patrick measures the length and the width of each rectangle by ruler and then calculates its area.

Patrick measures the length of the two adjacent sides of the square by ruler and then calculates its area.

Patrick counts the number of the 2 cm by 2 cm grids required to cover the L-shape.
Patrick counts the number of the 2 cm by 2 cm grids required to cover the square.

Patrick writes 16 cm$^2$ and 13 cm$^2$ in English words.

Patrick converts 3 cm$^2$ to mm$^2$, 4.7 m$^2$ to cm$^2$, and 1.25 km$^2$ to m$^2$.

Patrick draws two rectangles, labels its dimensions, and then calculates its perimeter and area.

Patrick draws two equilateral triangles and then calculates its perimeters and areas.

Patrick labels the missing sides of Diagram 1.

Patrick calculates the length of TR.

Patrick calculates the perimeter of Diagram 1.

Patrick calculates the area of Diagram 1.

Patrick uses alternative method to calculate the area of Diagram 1.

Patrick labels the missing sides of Diagram 2.

Patrick calculates the value of “A” using Pythagoras' theorem.

Patrick calculates the perimeter of Diagram 2.

Patrick calculates the area of Diagram 2.

Patrick draws the possible rectangular gardens and calculates their areas.

Patrick continues to draw the possible rectangular gardens and calculates their areas.

Patrick draws a rectangle, parallelogram, triangle, and trapezium, and then writes their respective area formulae.

Roslina’s selection of shapes that have a perimeter.

Roslina’s selection of shapes that have an area.

Roslina draws a large square on a 1-cm grid paper.

Roslina draws a 1-cm square on the grid paper.

Roslina measures the length of each side of the T-shape by ruler and then calculates its perimeter.

Roslina measures the length of each side of the rectangle by ruler and then calculates its perimeter.

Roslina measures the length and the width of each rectangle by ruler and then calculates its area.

Roslina measures the length of the two adjacent sides of the square by ruler and then calculates its area.

Roslina traces the L-shape on the 1-cm grid paper and counts the number of 1-cm square enclosed by the shape.

Roslina traces the square on the 1-cm grid paper and counts the number of 1-cm square enclosed by the shape.

Roslina draws the length of a paper clip in shapes A and B.

Roslina writes 16 cm$^2$ and 13 cm$^2$ in English words.

Roslina converts 3 cm$^2$ to mm$^2$.

Roslina converts 4.7 m$^2$ to cm$^2$.

Roslina converts 1.25 km$^2$ to m$^2$.

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Roslina draws two rectangles and then calculate its area respectively.

Roslina labels the missing sides of Diagram 1.

Roslina calculates the perimeter of Diagram 1.

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