Interactive White Board has its Specific Impact on Solving a Real Life Problem in Developing Mathematical Learning

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Abstract

This paper aims at presenting a specific strategy of using the interactive whiteboard in the learning development process of mathematics. Based on the characteristics of problem solving, Vygotsky's zone of proximal development and Bruner's scaffolding, the invasion of Information and Communication Technology (ICT) and Engestrom's activity theory, an example was carefully chosen and presented. This example is one of many that ICT, serving as a scaffolding tool, help the learner to successfully cross her/his zone of proximal development through an activity designed as a class work for Grade 8 learners. Teachers and facilitators are requested to follow such examples and develop some more to implement them as guiding experiences in their teaching process.

Keywords: Problem Solving, Scaffolding, Zone of Proximal development, ICT, and Interactive Whiteboards

1- Introduction

It is almost impossible nowadays that people do not use at least one mathematical concept during their daily life. Mathematics, Geometry or Algebra, is a main discipline in the K-12curriculum. Not only different concepts and theories are continuously introduced and applied in mathematics curriculum, but also the learning- teaching process of these concepts has developed and evolved throughout the years.

One way of teaching mathematics is by problem solving, especially real life problems. Real life problems or situations make things more concrete and close to the learner's daily life and consequently increases learner's engagement and fulfills her/his inquiry about "where and why do I need this?" When a real life situation is encountered, many elements must be considered: Problems directly related to the learned concepts, problems appropriate to learner's level and problems that are logical.

One way of solving problems is modeling. According to the article titled "Teaching and Learning Mathematical Modelling with Technology" (Ang, 2010), when a problem is being exposed to the learner, he/she transforms it into a pure mathematical problem by assuming, representing, and formulating equations that might help in reaching the solution. Then he/she tries to solve and make a link to the real life situation. Figure 1 shows how this process takes place.

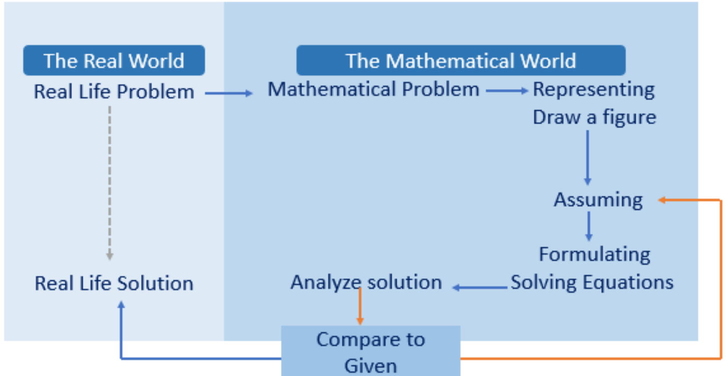


Figure 1: Problem Solving By Modeling inspired from Ang, 2010

For the learner not to face lot of difficulties in solving problems a new tool was implemented in the teaching learning process; it is considered part of the Information and communication technology (ICT). In a paper discussing the effective use of ICT for education (Noor, 2013), researchers claim that ICT evolved in a rapid pace to become one of the main elements to build society. Researchers emphasized that many countries nowadays master the skills of ICT as a main topic of their curriculum next to reading, writing and numeracy. According to a United Nation report (cited in Noor, 2013) , ICT does not only include the computers, LCD projectors and internet, it also includes the software and telecommunication, communication, documentation, media as well as other types of information and communication software. Researchers wrote down basic concepts that teachers should follow and consider; they should keep in mind that teachers are the leaders and not the ICT, they guide ICT, and that ICT is a tool to help them in having better outcomes.

Therefore, we aim here at emphasizing how the ICT serves as a tool in the educational process. ICT used as a tool in the scaffolding process that Jerome Bruner addressed in his Cognitive theory will help the learner to pass the Zone of proximal development defined by Lev Vygotsky.

It is admitted that ICT does not replace facilitators in the classroom but it is a feasible tool to be used by facilitators in order to improve the learning process. What is the best strategy of implementing ICT in learning mathematics? Do all ICT tools lead to the same improvement or are some tools better than others when learning mathematics?

Well any tool the facilitator implements in education in general must have its pros overcoming its cons; and accordingly, the decision follows whether to implement it or not. In this paper, an activity is designed to be conducted at the interactive white board (IWB) is our hypothesis to improve solving real life problems that require geometry of the math discipline.

2- Literature Review

Different ideas, branches, or divisions of the topic under discussion were approached by researchers worldwide. But there was no one research that tackled the integration of developing mathematical learning through real life problems to apply the geometric skills acquired in Grade 8 by implementing IWB as the tool to scaffold learners with illustrations, hints, guidance,…following the methodology of the third generation of the Activity Theory.
For example, an article titled “Teaching and learning Mathematical Modelling with technology” (Ang., 2010) emphasized the importance of ICT as a support in mathematical modeling of real life problems. The article presented different ICT tools shown in the following examples: (1) LoggerPro 3 software to capture the temperature of a cup of ice water as it warms to room temperature; (2) excel spread sheet to study queuing at a teller machine or ATM; (3) Geometer’s Sketchpad (GSP) to trace and study the motion of water spouting out a free discharge roof pipe; (4) and excel spread sheet and graphing to analyze epidemic data. None of the presented examples has to do with geometry neither the IWB as the used tool.

Moreover, in the Proceedings of the “British Society for Research into Learning Mathematics 29, 2”, (Nunez I., 2009) discussed the history of the three generations of the activity theory and came across its implementation in the mathematics classroom without presenting any detailed example on the issue.

“Embedding ICT @ Secondary-Use of interactive whiteboards in mathematics” is a booklet prepared by department of education and skills – BECTA covers detailed information about the features of the IWB and its benefits on teachers and students indicating the factors behind its effective use. In addition, under IWB and pedagogy, different case studies were presented and analyzed; one of which hits year 8 lesson on enlarging a geometric shape (IWB is used as a discovery tool to determine the point of enlargement of a given shape and to visualize what happens if the location of this point varies), another on fractions, a third case study on relating linear equations and straight line graph, a fourth on properties of quadrilaterals (applying the acquired properties of quadrilaterals), and the fifth case study is on sum and product in algebra. As indicated, neither of the discussed examples integrates between activity theory, scaffolding and solving real life problems by modeling.

What follows is the theoretical part that explains the main features of the theories that will be applied in planning and conducting the solution to the real problem to be discussed.

3- Theoretical Part

3.1- Problem Solving

Teachers, instructors and professors write down and design different kinds of problems that students have to solve. Most of the time problems are written based on a specific goal. A problem occurs when there is a situation that needs to be solved and the learner is not aware of the way to solve it. According to the Gestalt psychologist Karl Dunker (cited in Mayer & Wittrock, 2009) a problem is when there is an unreachable and inaccessible goal. In the same article, Mayer and Wittrock define problem solving asa process that works on achieving the required goal; this process is considered as a cognitive process because it works on the behavior and the cognition of the learner, it is guided by the solver’s goalsas well as it depends on learner’s previous knowledge.

Mayer & Wittrock (2009) claim that problem solving involves two kinds of thinking: ‘directed’ towards goals and ‘undirected’ like daydreaming. Thinking might include reasoning, decision making, creative thinking, and critical thinking. All of the above are strategies and ways used to solve a specific problem. Problems are also divided into two kinds: a well-defined problem which has a specified given, requirements and specific operations; and an ill-defined problem which is not clear and has no specific number of operations. Problems also can be routine, such as direct multiplication or non-routine such as having a problem that the learner does not directly know how to solve.

In their article Mayer and Wittrock (2009), they insure that a good problem solver need to master different skills that are summarized as follows: *facts* which are the learner’s knowledge of events, characteristics or so; *concepts* which are theories and principles; *strategies* which are the methods; *procedures* that might vary according to each concept; and *beliefs* where the solver needs to have self confidence in order to reach the goal.

In addition, the problem solver is supposed to pass through several cognitive steps to achieve the goal. These steps start with the *representation phase* in which the learner represents the problem by an unknown x in elementary algebra or by points, lines, circles… in geometry to understand the given data through an equation, inequality, or a geometric figure, identifies the requirements and decides on the possible operations; then follows the *planning phase* where the learner sets a plan on how to solve the problem; then the *executing phase* where the learner starts applying his/her plan and finally comes the *self-regulating and summing up or reviewing*. So the problem solving is not as easy as we think, a learner progress through many successive steps in order to reach his/her goal (Mayer and Wittrock, 2009).

3.2- Zone of Proximal Development and Scaffolding

Lev Vygotsky published an article in one book titled “Readings on the Development of Children” (cited inCole, 1997) where he said that learning occurs before entering the school. Figure 2 models the ZPD.

The Child begins to learn from the moment he/she is born. Vygotsky developed the Zone of Proximal development (ZPD) which is the margin between two levels of development: *the actual development* and *the potential development* (Lui, 2010). The first level, actual development, is the level where a child can do specific tasks independently without any help. The other level, potential development, is the level where a child is not able to solve a specific task independently and therefore needs the assistance and help of an expert to finish the task.

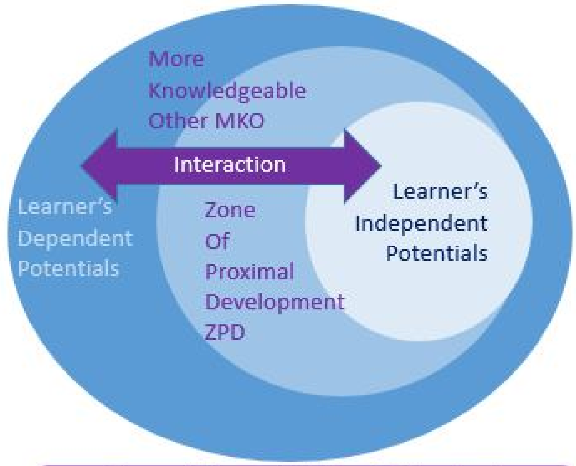


Figure 2: Vygotsky's Zone Of Proximal Development inspired from Vygotsky's work

According to Van Der Stuyf, Vygotsky defines ZPD as: "The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (cited in R. Van Der Stuyf, 2002, p 2).Scaffolding is the name Jerome Bruner assigned in 1952 to the process of helping and guiding that will enable the child to finish his/her work which parallels Lev Vygotsky's work on having an expert assisting the novice or apprentice to do something beyond her/his independent potentials. Later, Wood, Bruner, and Ross's (1976) continued the study on the topic of scaffolding. Figure 2 explains more how the process takes place. The teacher's role in this process might include planned aspects to motivate the child, simplify the tasks for him/her, direct him/her, decrease the difficulties that a learner might face and model to make things clearer(Stuyf, 2010).

3.3- Using ICT in Mathematics

The different motivating, effective, and creative tools available through ICT implementation will help the child in her/his learning development. In "Information and Communications Technology (ICT) in the primary School Curriculum: guidelines for teachers" published by The National Council for curriculum and assessment (2004, P3-P6 and P9-P11), the researchers stated 14 main principles indicating how ICT can help. Here are some of the principles which are related to our topic:

- "The child's sense of wonder and natural curiosity" about how the environment around him acts as a powerful motivation for the learner.
- "The child as an active agent in his/her learning" constructs his knowledge rather than acquires knowledge.
- "The developmental nature of learning" is recommended to be cyclic rather than linear so that acquired concepts can be revisited and checked every now and then.
- "The child's knowledge and experience as a base for learning"; the child builds on previous knowledge.
- "Environment-based learning", ICT expands the limiting walls of the classroom to accommodate the environment for different topics.
- "Learning through guided activity and discovery"; the teacher is now a facilitator who guides learners through well designed lessons to insure correct discovery through an interesting activity conducted in class.
- "Higher-order thinking and problem-solving", which trains learners to asking questions, analyzing, comparing, defining problems, accepting more than one answer or solution, and tolerating ambiguity….
- "Collaborative learning", which increases interactivity and engagement in class; and
- "Taking account of individual differences", regarding the factors behind difference in learning in addition to the multi- backgrounds of the learners.

In each of the above principles, ICT plays different roles and helps in developing and elaborating them. For example, ICT helps in creating something new, communicating with other children and exploring the World Wide Web in addition to helping the child in investigating, discovering, analyzing, solving problems, and sharing. ICT is integrated to enhance learning and teaching. Figure 3 explains the different roles ICT plays to help learners develop their thinking.

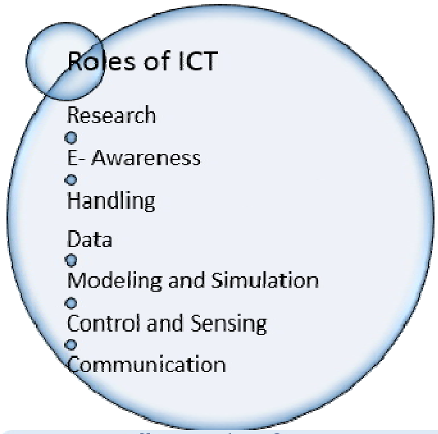


Figure 3: Different Roles Of ICT in Learning Development

One of the ICT tools used nowadays is the Interactive white board (IWB) which can be implemented in all K-12 disciplines. IWB gives the instructor/facilitator a more interesting teaching/guiding mean than the traditional common use of other tools. IWB allows for an interactive e-environment that can lead to better learning outcomes since it is addressing the learners' senses by having the potentials to integrate all the types of learning – audio, visual, and kinesthetic. According to Peter Kent, a Deputy Principal, in Australia (Kent, 2006), IWB develops higher order thinking skills for learners and triggers conversations depending on the learners' understanding of the subject taught. Through different examples and exercises, IWBs can virtually expose the learners to the world outside the class (society, community, world and to daily life matters).

According to a report about the use of interactive whiteboards in mathematics by the British Educational Communications and technology – BECTA (2004), IWBs improve teaching mathematics mainly in three areas:*1.Presenting, demonstrating and modeling; 2. actively engaging pupils; 3. improving the pace and flow of the lesson.* IWBs help the facilitator to use various ways of presenting the lesson to the learners and demonstrating the ideas through different feasible tools supported by the variety of options available in different software for the IWB. IWB allows facilitators to be more realistic when modeling a concept or while presenting a certain idea (directly draw in class, show previously searched or prepared figures/images, watch videos,…). In addition to navigating back and forth to ideas discussed and saved on different pages of the flipchart thus saving time for rewriting what was previously covered. Not only this, the learner can synchronize his computer with the IWB in class and save a copy of the flipchart done in class for home review and practice.

IWBs also allow for more interactivity, involvement and engagement of learners in the classroom. The different options found and the pre-prepared materials, links, graphs and others also help in making the flow of lessons easy, new, and different thus continuously motivating the learners to know what's next.

According to the same report by Becta's publication (2004), IWBs increase the enjoyment and motivation of the students; they can explore different learning styles and understand more complex concepts through explanation, demonstration, and hands on activities with immediate feedback. They have more opportunities for participation and therefore, develop more social skills. For example, the IWB allows for use of clickers by each learner individually to answer the same question at the same time and to get the results analyzed directly on a chart which can be visualized by the learners. Such type of assessment can be classified as formative and ongoing which saves time and positively forcing all learners to participate. A more advanced feature is an application for mobile phones when installed,the learners' mobiles can replace the clickers.

Extra opportunities that IWBs can provide were mentioned in an article titled " 20 cool things you can do on your interactive whiteboard" such as creating interactive activities, adding and using videos and sounds, working with pdf format files or direct internet document, navigating Google Earth and much more.
More of what the IWB can add to the teaching-learning process in the practical part.

3.4- Activity theory in Mathematics

According to Engestrom (Murphy and Manzanares, 2008), the third generation of the activity theory is based on five main principles:

1. The activity theory should be an activity system;
2. Since different people are involved in this system, there is a variety of interests, opinions and thoughts; consequently, diversity in the system;
3. The activity system is done over a time so the historical background and information plays a big role in this system and helps the system to be understood;
4. The system is based on contradictions where changes might differ from system to another and might be null in others. Most contradictions take place in the rules of the activity system;
5. Transformation can also take place in the activity system especially if it takes a long time to reach the outcome. The activity theory was presented in a triangle form that is shown in figure 4 below.

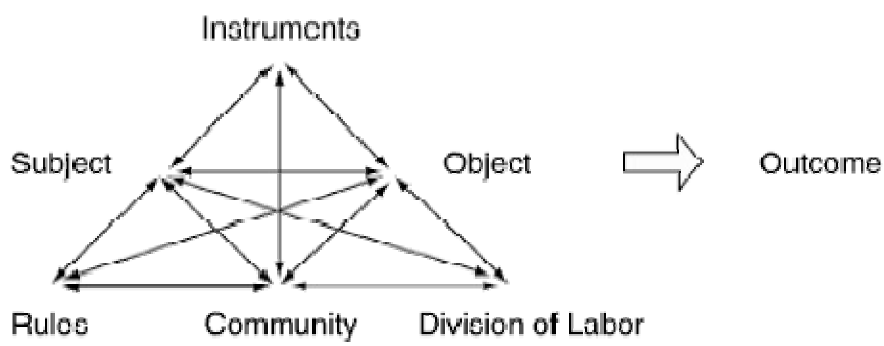


Figure 4: Components of the Third Generation of the Activity theory (Murphy and Manzanares, 2008)

The representation of the third generation of the activity theory shows different factors that can be explained as follows: the *subject* of the activity system describes the person or the group of individuals (student or the whole class) that are involved in the activity, the *object* is summarized by the problem space or the raw material that is changed later to the outcome with the use of the tools (long term or short term goal as passing an exam), and the *tools* which are of two kinds, external and internal (concepts, strategies and tools). The *community* symbolizes all the participants of the activity system that have the same objective (students, teachers, and family), the *division of labor* involves the division of tasks on the community members, and the *rules* are the things need to be followed within the same activity system (assessments, language, questioning the way of teaching) (Nunez, I. 2009).

4- The Practical Part

In what follows is a real life problem that we choose to study and work on using ICT as a tool to reach our goal. This problem has Grade 8 students as audience as its prerequisites are addition, multiplication, drawing rectangles, and determining the area of a rectangle.

4.1 Problem Situation

A mother told her child that he can have a new wallpaper in his room. The room is 18 feet long, 17 feet wide and 10 feet high. The room has two windows and one door. On the 18 feet long walls there aretwo windows, one on each wall. The window is 4 feet high and 5 feet wide and should be 3 feet above the floor. It is located in the middle of the wall. The door is located on the 17 feet longwall. The door is 7 feet high and 3 feet wide.

4.2 Knowing that

The following information must be familiar to the learners.

- The wallpaper is sold in double rolls and totaling 44 square feet.
- You cannot buy partial rolls of the wallpaper.
- Cost of one roll of wallpaper is $25.00.
- Area of a rectangle is width x height or width x length.

Required to find: What is the amount of rolls needed to cover the walls? What is the price? What will you do with the remaining parts if any?

4.3 Suggested Solution

The main ICT tool admitted as our instrument according to the third generation of Engstrom's Activity Theory is the IWB. The IWB is a computer connected to data projector to large touch screens, which allows direct input from people. IWBs have different software which have many properties and can be used to develop the learning process in general and learning mathematics in particular. IWBs are playing a big role in the educational process for both teachers and learners. According to the article "Interactive whiteboards in Mathematics teachings: A literature review" (DeVita, Verschaffel, & Ele, 2014, p2):

"Teachers are able to use IWBs for modeling mathematical ideas and strategies, demonstrating theorems, explaining difficult concepts, simulating discussion about topics… and challenging students to apply their mathematics to solve problems."

In the presented example, the IWB is deemed necessary from the very beginning of the solution which starts by how to represent the walls? Is the learner supposed to draw or the facilitator is going to ask leading questions until the learner discovers that the wall can be represented by a rectangle? If so, there is a need to explain and demonstrate how easy it is to draw a rectangle with specific dimensions using the IWBtools such as shape tool, ruler, or pen tool. The solution of the problem using the IWB is divided into sequential steps as follows:

4.3.1 Using IWB in solving the problem

Step 1: Start by displaying the given of the problem on IWB as shown on figure below

A mother told her child that he can have a new wallpaper in his room. The room is 18 feet long, 17 feet wide and 10 feet high. It have two windows and one door. On the 18 feet long walls there are two windows, one on each wall. The window is 4 feet high and 5 feet wide and should be 3 feet above the floor. It is located in the middle of the wall. The door is located on the 17 feet long wall. The door is 7 feet high and 3 feet wide.

Knowing that: - The wallpaper is sold in double rolls and totaling 44 square feet.

- *There are 9 square feet in 1 square yard.*
- *Cost of one roll of wallpaper is $25.00.*
- *Area of a rectangle is width x height or width x length.*
- *Area of square is width x width or length x length.*

Required to find: What is the amount of rolls needed to cover the walls? What is the price? What will you do with the remaining parts if there is any?

Figure 5: Display of the Given Data

Then, use the KWL chart (Know, Want to learn, what is Learnt). Jot down all the ideas that you have and all the notes.*Use the KWL chart template feature of the IWB to make things easier:*

What do I already know about this problem?	What do I want to know more to solve the problem?	What is the final solution?
all the given - measurments of the room, measurments of the windows, measuments of the door	locate the window locate the door find the area of the covered place find the amount of wallpaper needed	?

Figure 6: The KWL chart Template provided on IWB

Step 2: There is a need for a mathematical representation of the problem. The facilitator in this step starts asking the learners guiding questions to help them represent the wall of a room by a rectangle. For example: What is the geometric shape of the room if one side is 18 ft and the other side is 17ft? Is it a square or rectangle?

To remind the students of the geometrical shapes a flipchart can be linked to show the properties of each.

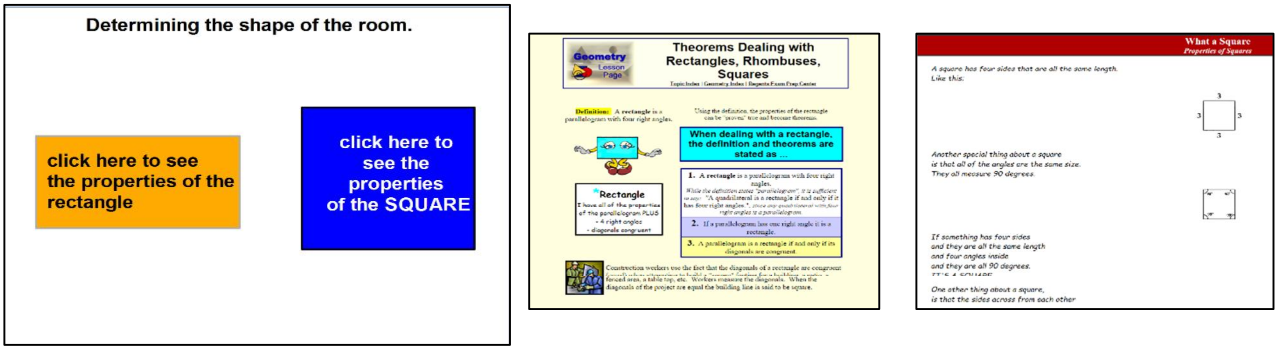


Figure 7: The Display on IWB to Refresh Students Knowledge of Geometric Shapes

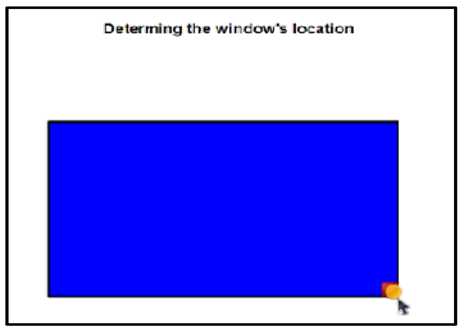


Figure 8: How the IWB Displays a Rectangle to Represent the Wall

Step 3: After determining the shape of the room, the window on the 18 feet wall is to be located on the rectangular wall. Another set of guiding questions is required as: what is the shape of the window knowing that it is 4 feet high and 5 feet wide? What is the area of a rectangle? Where is the center of a rectangle? Draw the window.

One of the students will be asked to use the shape tool on IWB to draw the rectangle.

Ask more questions. We know that the window is 3ft above the floor and that its height is 4 feet, what is the distance from the upper edge of window to the ceiling? Remember that you know that the height of the room is 10 feet.

A figure will be presented using the pen tool and the shape tool to express the given above.

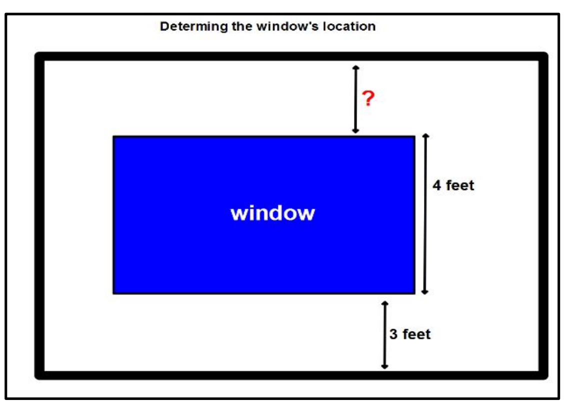


Figure 9: Show Dimensions to Determine x

Let *x* be the distance from the window to the ceiling. We know that the hieght is 10ft and the distance from floor to window is 3 feet and the window's height is 4 feet then the remaining part is:

$3 + 4 + x = 10$
$7+x = 10$
$x = 10-7 = 3$ ft

Therefore, the distance from the upper edge of the window to the ceiling is 3 ft.

By clicking on the question mark, learner will know the correct answer. A tooltip caption is used in this case.

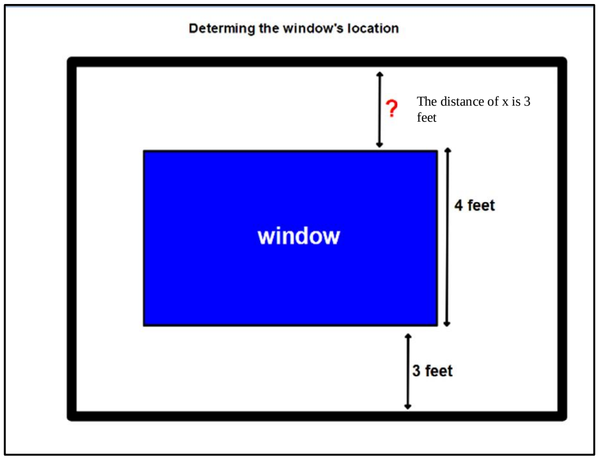


Figure 10: What is Displayed when learner Clicks on the Red Question

We located the window vertically, let us locate it horizontally. We know that the edge of the window is equidistant from the walls.

What is the meaning of equidistant?
Click the magic ink tool to see.

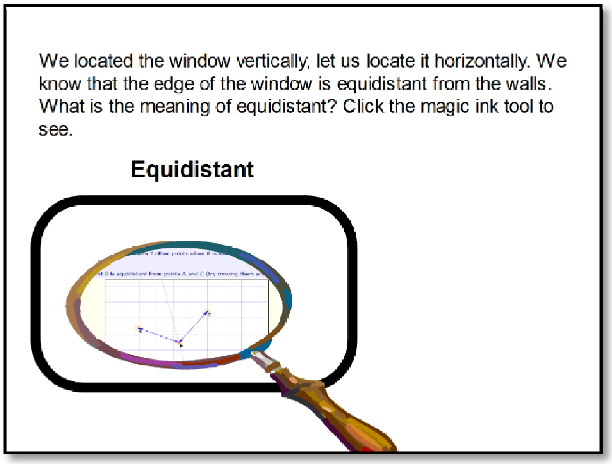


Figure 11: The Use of the Magic ink to Remember the Meaning of Equidistant

What is the distance between the wall and the edge of the window?

Let Y be the distance equidistant from the edge of the walls and we know that the lengthof the wall is 18 ft and the length of the window is 5 ft, then:

$Y + Y + 5 = 18$
$2Y + 5 = 18$
$2Y = 18 – 5$
$2Y = 13$
$Y = 13/2 = 6.5$ ft

Another page will show the answer.

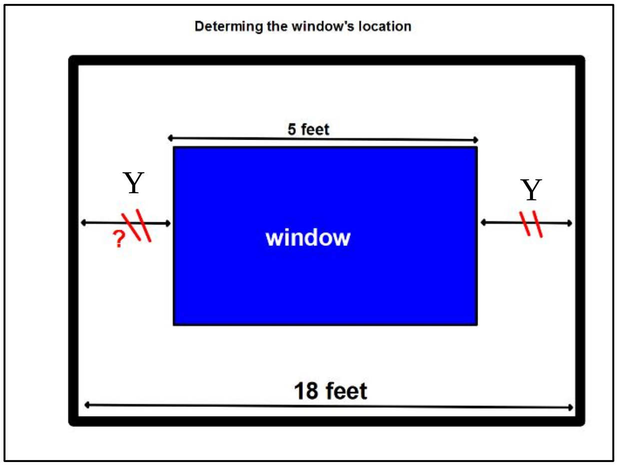


Figure 12: To Locate the Window Horizontally in Middle of Wall

Ask the learners to present all the information they got on the IWB.

In order to present the required information, the learners need to use many tools on IWB; they can use the ruler to draw as well as the shape and pen tools. They can use the text tool or the handwriting recognition tool to show the information. Then the revealer will be used to show the final page on the flipchart prepared by the teacher.

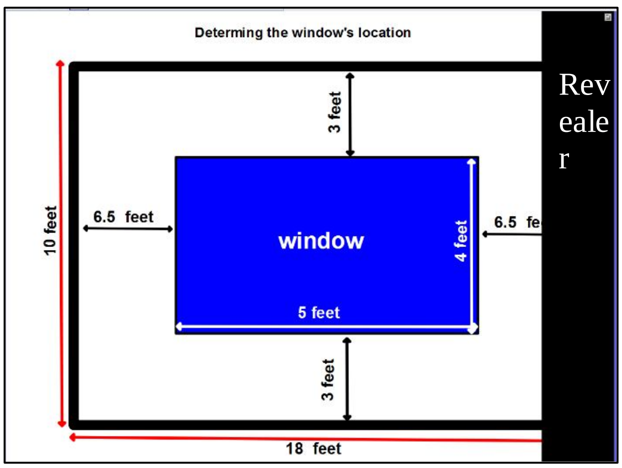


Figure 13: The Revealer Feature on IWB

Step 4: Proceed with the leading questions: We located the window; do we need to locate the second window? On which wall is the second window, the 17ft or the 18 ft wall? Are the two windows the same? Where is the second window located then?

Such questions lead the learner to conclude that the two widows are on two identical walls and there is no need to repeat the same steps.

Now let us find out the amount of wallpaper needed to cover these two walls.

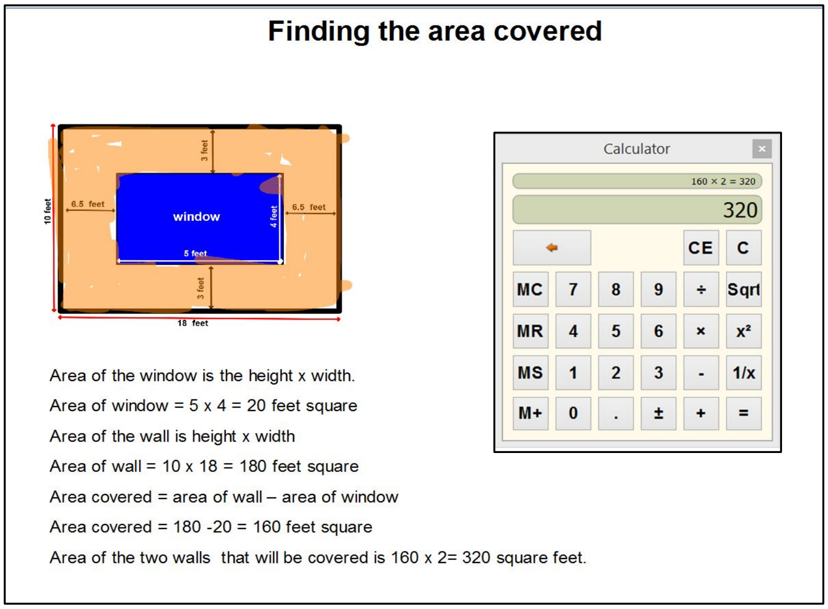
Do we need to cover the window? What should we do? Should we find the area or the perimeter? What is the area of the window? What is the area of the wall?

After answering all of the above questions, we start solving.

Tools like the calculator and the equations can be implemented here.

Area of the window is the height x width.
Area of window = 5 x 4 = 20 ft^2
Area of the wall is height x width
Area of wall = 10 x 18 = 180 ft^2

Then the area covered is: Area of wall – Area of window, and consequently
Area covered with wall papers is: 180 -20 = 160 ft ^{2}
Area on the two walls that will be covered with wall papers is 160 x 2= 320 ft ^{2}.



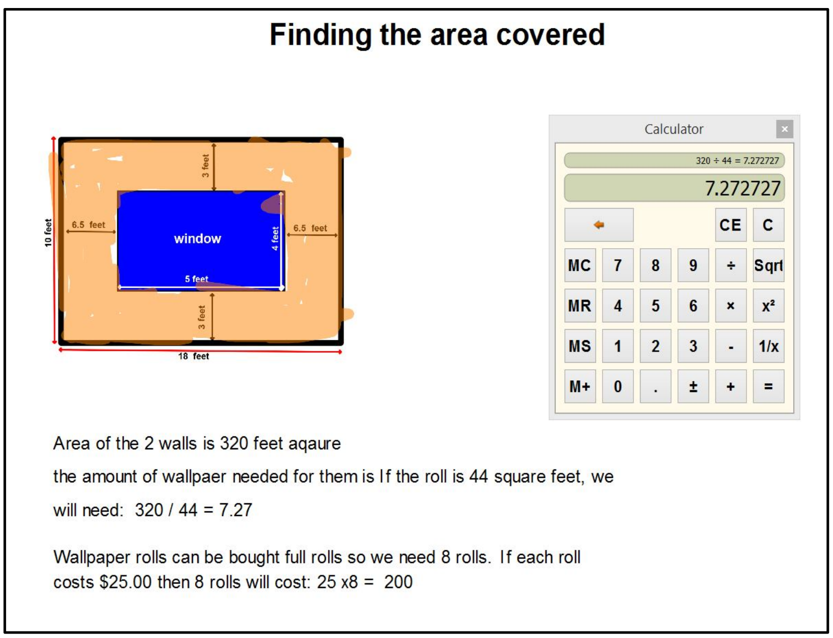


Figure 14: The Use of the Calculator Next to the Mathematical Representation of the Problem

Step 5: We have to find out the amount of wallpaper needed to cover these two walls.

Area of the 2 walls is 320 ft ^{2}.If the roll is 44 ft ^{2}, then the amount of wallpaper needed will be: 320 / 44 = 7.27
Wallpaper rolls can be purchased in full rolls so we need 8 rolls.

If each roll costs $25.00, then 8 rolls will cost: 25 x 8 = 200 $

Following the same strategies, we will be calculating the area needed to be covered with wall paper on the other two walls of the room. We will guide the learner to locate the door in the same way we located the window, then we will calculate the area covered by wallpaper of the remaining two walls and then we calculate the amount of wallpaper needed.

Step 6: To answer the last question: "What to do with the remaining roll papers?"

After dividing the wallpaper on the wall, we notice that we have some remaining wallpaper. *A final image will be presented to show the final division of the wallpaper.*

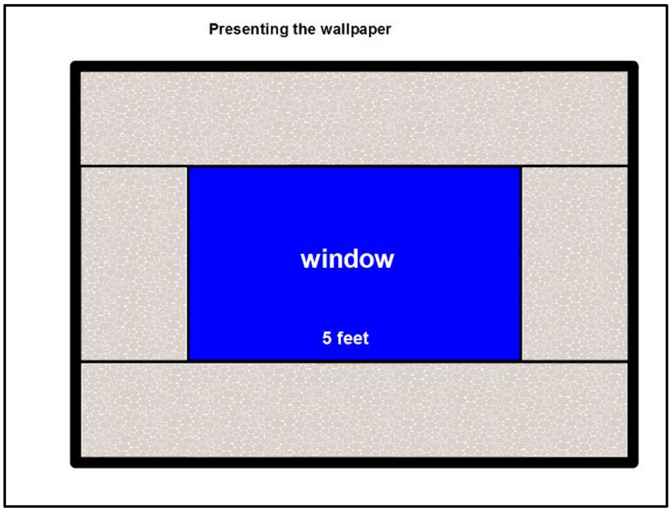


Figure 15: Showing the Division Wallpaper Areas on the Wall

Ask the learners "what will you do with the remaining wall paper?"

Guide them through discovery what can be done with the wallpaper pieces. *Use the spotlight tool to give hints on how to use the leftovers.*

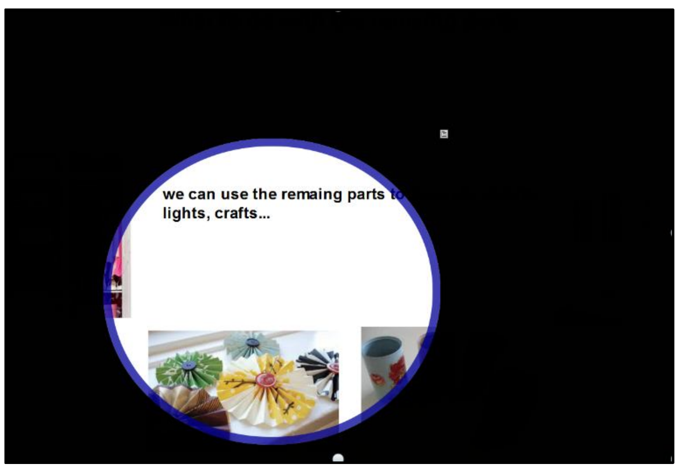


Figure 16: Spotlight to Show Hints

4.3.2 Analysis of the Solution

The problem situation presented above consists of several characteristics which can be summarized as follows:

1) The problem is a real life situation that might face any individual.
2) It requires several steps to be followed.
3) The goal is to know the cost and number of rolls needed to cover the walls and the division of walls into rectangles of various dimensions to cover the walls. To reach this goal learners should know the location of the windows and door in the room.
4) Learners should know the strategies and procedures that will take place and work according to the cognitive process by representing, planning, executing and self-regulating.
5) The learner should start by a convincing geometric representation of the problem which is a set of rectangles.
6) Many algebraic operations should be carried out in order to find the final solution of the problem.
7) The learners need to know all the mathematical concepts concerning the area of rectangle as well as the addition, subtraction, multiplication and division.

8) This problem is a direct well-defined problem where all information are specified and where reasoning, creative thinking and critical thinking skills are used.

The start is by implementing 'problem solving by modeling': The learners can convert the real life situation by simple combinations of rectangles representing the walls, windows, and door in addition to subdividing the wall areas into least number of rectangles to cover them with wall papers. Then the learner can continue the solution using mathematical properties (area of a rectangle) and algebraic operations (multiplication, addition, division and subtraction). This step can be easily done and visualized using the IWB which embeds within its software the ability to draw using the geometric tools, to show the dimensions of each rectangle, to carry out the arithmetic operations and reach answers using the calculator. Solving such a problem requires a well- designed interactive activity to be conducted in the classroom.

Despite the fact that the IWB combines the needs of representing, visualizing, and calculating the answers, Grade 8 learners do not have the independent potentials to manage all the sequential operations of the 'modeling' and 'solving' to reach the final solution. Therefore, as soon as the Grade 8 learners read the given of the well-designed real life problem, they enter in their ZPD (keeping in mind that it may differ from one learner to another). Being in their ZPDs, learners need the scaffolding phase of the expert or the more knowledgeable other (MKO) to help them invest their dependent potentials to cross their ZPDs. In this problem the MKO is the teacher or facilitator who is the designer of the activity on the IWB. Facilitator poses the leading questions to every step and through technology uncover the correct answers after the learners discover it by using the 'magic ink', 'revealer', and other interactive features of the IWB.

In the triangular representation of the third generation of the activity theory there are many elements which address the scaffolding process. The scaffolding process will take place by guiding the learner to use the instrument (interactive whiteboard) leading them to draw, locate, divide and know exactly the rectangular geometric forms obtained whose areas are to be determined. When this process is over and the learner forms a clear image about the walls and what each wall contains he/she is able to calculate the area and calculate the number of rolls as well as the cost of the wallpapers that is needed.

To specify the characteristics of this problem according to the activity theory, figure 15below represents the different elements of the activity theory triangle in this problem. The *subject* is represented by the learners. The *object* is the final solution of the problem which is the division of walls, number of rolls needed, cost of rolls and what to do with the remaining parts. The *rules* are to follow the correct order of operations and to follow the scaffolding process in the finding of the solution. The *community* represents the teacher and the learners. The *division of labor* presents the steps that we need to do to reach the object; these steps are the drawing of walls, locating the positions of the windows and door, dividing the walls, calculating the areas, calculating the number of rolls and cost, and finally stating what to do with the remaining parts. The *instruments* that will be used in the problem are the ICT tool that is represented by the IWB

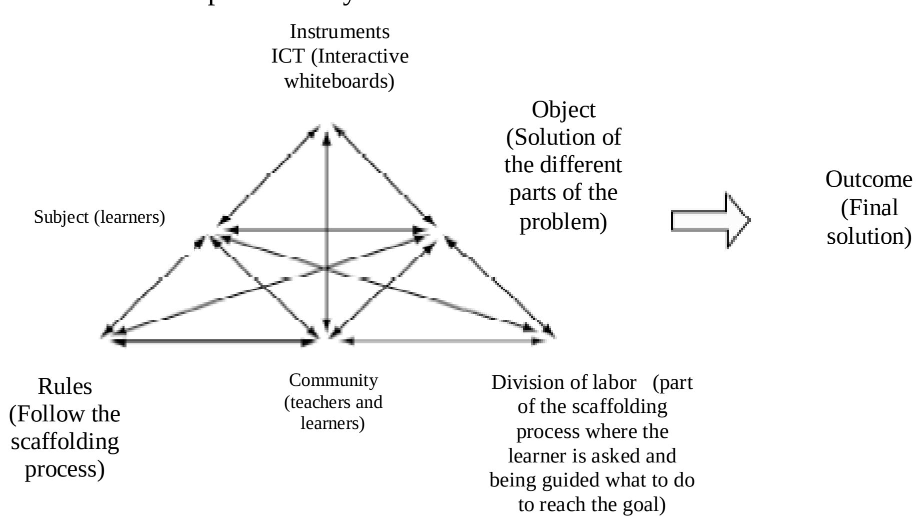


Figure 17: Third Generation of the Activity Theory applied to solve the problem

5. Conclusion

The presented real life problem is one of many explicit examples that shows how the ICT can be used as a tool in the learning process of mathematics. This tool is one of the poles of the activity theory implemented in the scaffolding process, used as a guide, where the teacher/facilitator helps the learners to cross their ZPDs. It is used to fill in the gap of traditional teaching that leaves many learners behind understanding mathematics in general and geometry in particular. The IWB is more used in guiding the learner to locate the windows and door rather than in calculation. Locating the window and door is an important stage of the solution for learners to know exactly how to cut the rolls and put them on walls of the room; otherwise, they might need more rolls and consequently pay more money to finish the mission of covering the walls with roll papers. Learners do not only need to calculate the number of rolls and the cost, they have to cut the rolls according to the sizes of the spaces suitable for each wall. A more advanced question to the learners is to look for the optimum solution - meaning the division of walls into rectangles that fit the width of the wall paper roll. This can be an opening for future designs of the solution using the IWB.

This example serves as showing the Math teachers as well as other discipline teacher to use this tool in theory teaching process and how to work on guiding the learners and working on the social and communicational skills.
Flipcharts and IWB tools will also be used to explain more and more about the solution of the problem. The tools represented above were few of many found on the IWBs. There are plenty of tools such as equation tool, polygons, graphs, tables, revealers drag and drop, compass, and much more.

Using mathematical tools tab makes a big difference in the learning process for both teachers and students. Learning with the IWB leads to more interactive and motivating classes. IWBs area helping in solving difficult, abstract and complex problems.

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