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ABSTRACT

A good mathematics instructor is a proficient organizer of pupils for instruction in mathematics. There are many specifics involved in organizing for instruction. This paper discusses organizational structures in mathematics instruction such as learning stations. "A Geometry Center" is provided as an example of a learning station. The organization of instruction in unit teaching and the evaluation processes used by pupils are also discussed. (ASK)

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ORGANIZATIONAL STRUCTURES IN MATHEMATICS

A good mathematics instructor is a proficient organizer of pupils for instruction in mathematics (Ediger, 1997, pp 18-38). Here, the teacher has numerous incidental ways for pupils to learn mathematics. Bulletin board displays which illustrate selected facts, concepts, and generalizations in mathematics can assist pupils to obtain needed background information on their very own. The bulletin board display may also be used in direct teaching of pupils as they relate to an ongoing lesson or unit of study. One of the best stimulating bulletin board displays I observed when supervising student teachers and cooperating teachers in the public schools emphasized a history of measurement. Many pupils were fascinated with the display by noticing how the centimeter, meter, and kilometer had their beginning or origin. I think the bulletin board display here helped pupils to learn more about measurement. Many pupils spent much time viewing and discussing the bulletin board display. The mathematics teacher needs to take down a display when it has served its purpose and prepare a new one which encourages pupil learning.

Using Learning Stations

The mathematics teacher may organize pupils for instruction by developing a set of learning stations. Each station needs to be labeled so that pupils know what to expect at the center. I suggest that each learning station have concrete (objects, items, and realia) for pupils to learn from. These concrete materials stimulate and motivate pupil learning. Semiconcrete materials (illustrations, slides, videotapes, filmstrips, CDs, computer software and personal computers, as well as films should also be located at each station, along with abstract learning materials such as textbook and workbook materials, photocopied problems, reading activities, writing experiences, listening/participating through discussions and cassette recordings, among other tasks. The concrete, semiconcrete, and abstract materials may become a part of the tasks on task cards. One task card per center should be in evidence. A fine set of tasks one cooperating teacher wrote was the following as an example:

A Geometry Center (Grade Three)

1. take four geometrical figures from this station and find the perimeter of each.
2. select two geometrical figures and find the area of each.
3. make your own geometrical figures and develop an art project which shows a new scene.

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2

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4. view the filmstrip entitled Geometrical Figures and answer the related questions located next to the projector.

5. view and discuss with five other pupils content in the videotape entitled Geometry is fun. Write five main ideas gathered from your discussion.

The mathematics teacher should have an adequate number of tasks at the different stations so that a pupil may omit what does not possess perceived purpose and yet there are ample activities for time on task for each learner. The mathematics teacher assists and guides pupils to achieve and learn at the diverse stations. He/she does not lecture to pupils. Each pupil should be actively engaged in learning. Peer assistance and help should be welcomed as needed. Learners may choose individual as well as collaborative tasks to pursue (see Reys, Suydam, and Lindquist, 1995).

The philosophy in back of learning station use is that pupils will achieve more if they may choose what to pursue and what to omit. A teacher may arrange stations so that pupils may experience the basics as well as activity centered approaches. Much is written about stressing a hands on approach in guiding pupil learning in mathematics. With ample concrete and semiconcrete experiences available in terms of materials and listed tasks at each station, pupils may certainly experience a hands on approach in learning. At the same time, there are ample opportunities for pupil learning that provide for individual differences and learning styles (Ediger, 1995, 13-15). If too many pupils wish to work at a station, the teacher may assign pupils to the different centers so that a reasonable number may work together. Before pupils start working at a station, the teacher should introduce each station to pupils. The introduction should also encourage and motivate pupils to learn. Individual needs are met of pupils through choice of sequential activities as well as by choosing individual versus collaborative endeavors. With an adequate number of tasks available, pupils may omit what does not meet personal needs and learning styles. The teacher evaluates each pupil within the framework of continuous achievement at the diverse stations. Organization of pupils for learning is an important task of the mathematics teacher.

The teacher needs to communicate clearly to pupils proper rules for learning and enforce these regulations. He/she needs to observe learner behavior and attempt to prevent disruptions from occurring. Many school districts and schools have policies on school discipline that must be enforced. An orderly environment helps pupils to achieve more optimally. The teacher needs to evaluate the learning environment continuously and work in the direction of making changes to continually motivate pupil learning. Materials of instruction should be readily available to pupils. They need to be current and attractive to encourage

learning. A safe classroom environment guides pupils to learn. Ridiculing, belittling, and sarcasm are not models for good behavior. There needs to be respect for pupils as well as for the mathematics teacher. All involved in a class need to experience a wholesome environment for teaching and learning (Ediger, 1996, pp 172-192).

The ideal in learning is self discipline. Intrinsic motivation might well then be in evidence. Different positive approaches must be used to reward proper behavior such as verbal praise for work well done by the learner. All like to be recognized for achievement, and esteem needs of pupils and the teacher must be met in the classroom. Improper behavior needs to be identified and corrected. The correction(s) made in pupil behavior must emphasize positive approaches. These approaches serve as models for others to emulate. Discipline problems cannot be overlooked and may need administrative help. School board policies on remedying discipline problems need to be enforced. Teachers need to teach and not be bothered by disrupters in the classroom. The following are pointers for the mathematics teacher to stress:

1. guide pupils to develop a good self concept by being successful in every day experiences in mathematics.
2. work in the direction of pupils individually being responsible for their very own behavior.
3. know the name of each pupil personally and be familiar with the learner's interests.
4. help pupils to develop respect for each other and for the teacher. Correct unacceptable behavior of pupils with a positive alternative.
5. be available to assist pupils when this is needed.
6. accept all pupils and show a caring attitude for learner achievement.
7. assist each pupil to achieve high standards in the mathematics curriculum.
8. have high, reasonable expectations for each pupil.
9. reward with praise those pupils who do well in mathematics.
10. emphasize rational balance among knowledge, skills, and attitudinal objectives.

The mathematics teacher should stress meeting esteem needs of pupils. Thus, there is recognition for pupils individually as well as in groups who are achieving vital objectives in mathematics. The emotional well being of a child is of utmost importance when developing the mathematics curriculum. Equally salient is the physiological needs of pupils. These need to be met if pupil are to do well in mathematics. A hungry, malnourished pupil cannot do well in ongoing lessons and units of study. In addition to free and reduced prices of school lunches, free breakfasts should be served to all needy pupils. Why? More optimal

achievement in mathematics is then possible. Each pupil needs to have physiological needs met in school as well as in the home setting. I know it is a problem to emphasize adequate food, clothing, and shelter for all pupils when the poverty level for pupils is at the twenty-five per cent level for pupils in this country, a nation of plenty. However, teachers do need to inform parents in needy situations of available food pantries and places where clothing is available at no cost. There are numerous churches that provide free clothing to needy people. The Salvation Army also has free clothing available as well as food, in many cases. Again, meeting the physiological needs of pupils is important in guiding pupils to achieve more optimally in mathematics. To meet shelter needs of poor people, in particular, I recommend teachers becoming advocates of meeting the needs of all people. This represents the highest form of patriotism to me.

Organizing for Instruction in Unit Teaching

To initiate a new unit of study in mathematics, the teacher needs to use initiating activities. I would suggest the following ways to initiate or begin a new unit in mathematics:

1. complete a bulletin board display. This display should be located where all pupils may see the contents clearly. The contents of the bulletin board may be used for incidental learning as well as for direct teaching. In observational visits made to observe student teachers and cooperating teachers whom I supervised in the public schools, one bulletin board display truly sticks out in my mind. Here, the teachers had arranged a neat attractive caption entitled "Finding the Circumference of a Circle." A large circle of red colored yarn was shown with a piece of yellow colored yarn going through the midpoint (the radius) of the circle. A colored piece of green yarn emphasized the formula for pi (approximately 3.14). Clear descriptions were provided as to what is meant by pi and its relationship to squaring the radius and multiplying that value by pi. A very meaningful description was given on why the radius was squared and then multiplied by pi. Meaning theory is very important in mathematics teaching.

The bulletin board display needs to be appealing, neat, clear, and meaningful to pupils. In addition to the bulletin board display, there should be objects for pupils to manipulate in a hands on approach to learning. To teach the finding of the area of a circle, I suggest that enough small circles be available so that each pupil has one in the classroom. Each circle needs to have the center clearly marked with a point. Straight edges should be readily at the finger tops of pupils so that measurement of the radius is possible. Hand held calculators also should be easily accessible to pupils so that they may do the necessary

multiplying. Using paper and pencil is also important in learning to do the necessary computation. Personal computers should be there for pupils in order that skill is developed in its use when computing is necessary. Real objects that contain circles need to be present for pupils to observe such as bicycle wheels. Illustrations of the many uses for circles may be shown with car, truck, and tractor wheels.

A rich learning environment of concrete, semiconcrete, and abstract materials need to be in the offing for pupil use in active engagement and problem solving.

Next, the teacher should mention to pupils the objective or objectives to be achieved in the first lesson. This may stress inductive or deductive learning. The teacher may now use the materials mentioned above to begin teaching the new unit of study. Securing the attention of all pupils is important initially and as the lessons progress. Pupils need to be actively engaged in the lesson by observing, measuring, solving problems, as well as thinking creatively and critically. Active involvement by each pupil is necessary. The teacher may model as well as pupils may model to other learners what needs to be done to determine the area of a circle. Pupils in many cases may challenge each other to learn and to achieve. The teacher needs to check to see that each pupil understands and attaches meaning to what is being taught. The teacher should ask pupils what the meaning is of pi, as well as of squaring the radius.

Pupils should have ample opportunities to determine the area of circles that are in the classroom, be it in an illustration or realia. Ample use needs to be made by pupils of what has been learned. The level of application in teaching is of utmost importance. Facts acquired by pupils, such as the formula for finding the area of a circle is important if pupils can use and apply the information. Emphasizing relevant facts then may be vital in teaching and learning.

In the above implemented lesson, pupils practiced the following skills:

- 1. problem solving-- finding the area of a circle.**
- 2. critical thinking-- using relevant information as compared to discarding that which is not useful.**
- 3. creative thinking-- determining novel ways of finding the area of a circle.**
- 4. interpersonal work whereby pupils work collaboratively.**
- 5. intrapersonal endeavors in which pupils individually do the task at hand.**

In that same lesson, the mathematics teacher stressed the following:

- 1. an appropriate sequence in learning for pupils was emphasized whereby pupils experienced the concrete, semiconcrete, and abstract**

facets of achievement in that order.

2. readiness for the new learnings was evaluated.
3. motivation for learning was encouraged with a stimulating environment.
4. diagnosis and remediation was stressed in pupils' work pertaining to determining the area of a circle.
5. a variety of learning opportunities were in evidence.

In any lesson taught, the teacher needs to be certain that pupils understand what is involved when determining the area of a circle. He/she needs to appraise if pupils understand and are ready to compute the area of the circle with teacher assistance and also independently (Ediger, 1996, 95-101).

Evaluating Processes Used by Pupils

Too frequently, educators feel that all is well if cooperative learning is stressed in mathematics. I would suggest teachers evaluate the following in committee endeavors:

1. if all pupils are treated with respect.
2. if each pupil is doing his/her fair share of the work within the committee.
3. if learners are on task and achieving optimally.
4. if peers provide assistance as needed.
5. if learners individually are given a chance at the interesting tasks, not the routine largely or only.

Pupils need to work independently on tasks in mathematics. Life itself emphasizes that individuals be able to profitably use spare and independent time wisely. The following criteria need to be followed by pupils working in an intrapersonal manner:

1. the pupil is working constructively in completing the lesson on time.
2. the pupil is trying to solve problems independently.
3. the pupil asks for help when necessary.
4. the pupil is neat and accurate in school work involving mathematics.
5. the pupil shows positive attitudes toward the work and world of mathematics.

The mathematics teacher needs to be able to manage pupils well and in a caring manner when stressing large group instruction. Here, the teacher may

1. introduce the lesson to the entire class using objects, pictures

of the realia, and abstract symbols and numerals. Motivating pupils with quality materials of instruction as well as the teacher's effective use of the voice can do much to obtain learner attention and interest. The voice of the teacher should emphasize appropriate stress, pitch, and juncture. Stress in language use indicates certain words are pronounced louder than others within a sentence. Why? To communicate ideas more effectively to others. Pitch is a term that emphasizes certain words be said at a higher tone level as compared to others; in music, notes are pitched higher and lower to convey the intended sequence. In oral communication too, words need to be pitched higher and lower so that effective presentation of content is in evidence. In addition to stress and pitch, the mathematics teacher needs to pay attention to juncture. Juncture has to do with pauses at appropriate places such as when there are commas, periods, colons, and semicolons in written discourse. Using stress, pitch, and juncture has to do with oral use of language. I suggest that mathematics teachers use cassettes and videotapes to record their own teaching. The results can be listened to and evaluated such as in the video tape to notice where improvements may be made in oral communication. It is important for a teacher to be a good communicator of ideas, be it in explanations of processes in mathematics or as a leader in a discussion group. The pace or rapidity/slowness of the communication process also needs adequate emphasis. The point is that pupils need to be able to acquire necessary ideas in oral communication from the teacher in teaching and learning situations.

2. In small group instruction, the mathematics teacher needs to be able to have pupils move toward their designated groups quietly and quickly so that the instructional processes are disrupted minimally. In smaller groups, pupils with teacher guidance may explore and clarify ideas presented in the large group session. Additional activities here include

1. completing assignments made in the large group session.
2. extending learnings presented in the large group session.
3. experiencing enrichment activities.
4. developing a committee project.
5. videotaping a small group discussion.

Learning opportunities need to harmonize with the objectives of instruction. As an example, The National Council Teachers of Mathematics (1989) listed the following for grades K-4:

1. construct number meanings through real world experiences and the use of physical materials.
2. understand our numeration system by relating counting, grouping, and place value concepts.
3. develop number sense.
4. interpret the multiple uses of numbers encountered in the real

world.

Small group activities need to present challenge and richness of experiences to pupils in mathematics. In addition to large group and smaller group instruction, the mathematics teacher also needs to organize instruction for individual endeavors of learners. A variety of learning opportunities need to be in the offing to develop and maintain learner interest in learning. I suggest the following for individual activities for pupils:

1. working on a self selected task planned with the mathematics teacher.
2. selecting tasks to complete at an enrichment center.
3. receiving extra credit for additional learning activities completed, other than what is assigned.
4. choosing another pupil to do an agreed upon task extending what had been learned in an ongoing lesson.
5. making mathematical models of what is being stressed in terms of relevant lesson/unit objectives.

The mathematics teacher must be a good organizer of pupils in order to stress flexible grouping with large group, small group, and individual methods of teaching.

3. The teacher needs to think of a quality way to end a unit of instruction in mathematics. The learning opportunities here to culminate a unit in mathematics may include the following:

- a. review what has been learned.
- b. relate ideas acquired in mathematics.
- c. clarify subject matter not understood.
- d. diagnose and remediate what pupils did not attach meaning to.
- e. evaluate pupils progress through testing, portfolios, checklists, rating scales, and journal entries.

The advantages of using several kinds of assessments, some of which are embedded in instruction, is that student's evolving understanding can continuously be monitored. The disadvantage is that such a procedure is perceived cumbersome. Records of student achievement should be more than a set of numerical grades or checklists; they can include brief notes or samples of students' work. Such records are evidence of students' continuous growth in understanding. Students should also maintain their own records. At all grades students can keep portfolios of their work; in the higher grades, as they become more verbally fluent, they should be encouraged to keep a mathematics journal. These journals contain goals, discoveries, thoughts, and observations, as well as descriptions of activities. Journals allow

students, not only to chart their progress in understanding, but also act as a focus for discussion between student and teacher, thereby fostering communication about mathematics itself (National Council Teachers of Mathematics, 1989, p.36).

Conclusion

The mathematics teacher needs to be a good organizer of pupils for instruction. There are many specifics involved in organizing for instruction. Pupils need to be grouped properly for instruction into large, small, and individual study groups. Pupils need to be placed into groups so that more optimal achievement is an end result. Unit teaching emphasizes that pupils experience good initiating activities to begin a mathematics unit of study. The initiating activities need to motivate pupils in wanting to achieve. Once the unit of study has been initiated, the teacher emphasizes developmental activities to stress depth teaching and learning. Culminating activities end a unit successfully. With initiating, developmental, and culminating activities, pupils need to experience meaning, interest, and purpose. A variety of learning experiences need to be in the offing including concrete, semiconcrete, and abstract materials of instruction. Diagnosis and remediation pinpoint and remedy errors made by pupils.

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