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THE LES INSTRUCTIONAL MODEL: LAUNCH - EXPLORE - SUMMARIZE

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The LES Instructional Model used by the Middle Grade Mathematics Project reflects definite assumptions about content, learning and teaching. To effectively teach activities in accordance with this model requires an understanding of (1) the mathematical content and tasks for which the model is appropriate, (2) the process by which students are expected to learn the mathematics, (3) how an activity is to be structured and the content organized, and (4) the techniques recommended for presenting the mathematics and interacting with students as a class and individually.

Understanding the motivations behind the script of an MGMP activity enables a teacher to be more effective in following directions and making decisions to produce the desired learning environment. Success in implementing MGMP activities also contributes to the next step--using the LES Model to design and teach activities.

The LES acronim refers to the instructional phases of an activity--the Launch, Exploration and Summary. Organizing a lesson into three phases is not the distinctive feature of this model since most mathematics is taught with three recognizable components. Class periods typically begin or end with the checking of answers. For each new task or page in the textbook, teachers introduce or review the material and assign problems to be done as seatwork or homework.

The important distinctions between common practice and teaching as characterized in the LES Model are found in the nature of the content goals, tasks, and instructional technqiues. Differences are also apparent in the assumptions made about learners and learning. Descriptions of the important characteristics of the LES Model are given in the following sections on goals and assumptions, organization and structure, and teaching techniques.

Goals and Assumptions

The instructional goals of the LES Model are concerned with the mathematics to be learned and the type of learning environment to be created. Appropriate content goals include some form of pattern recognition. Being a broad goal, pattern recognition refers to such varying behaviors as identifying the necessary attributes of a concept, a rule for computing some value, a relationship between numbers, measures, shapes or variables, or even the best strategy for playing some "game".

Pattern recognition occurs as the result of performing a task and carefully examining the results or reflecting on the process. An appropriate choice of task, therefore, is vital to an activity where pattern recognition is the goal. Unfortunately, teachers often select a task for a lesson without realizing its potential for pattern recognition or without knowing the task is inadequate for the mathematical goal.

Equally important is the way in which data and experience are examined. The sequence in which data is obtained or recorded during a task may not facilitate the detection process. Consequently, data often needs to be re-organized in some manner such as a table of numbers or an arrangement of concrete models. While recognition of patterns is an obvious and necessary step in satisfying a content goal for patterns, it is not enough. Students also need to be able to apply the emerging concepts, rules, relationships and strategies.

Effective problem solvers need to understand concepts and patterns, not simply to know workable procedures. Students gain this understanding by actively constructing their own knowledge. The key words are "active" and "construct". For a learner to be active means to be engaged mentally and often concretely as well. For active construction of knowledge to occur requires that students have opportunities to formulate and check their conjectures, opportunities which allow the risk of failure.

Since students necessarily formulate their own interpretations of the mathematics being learned, it is only natural that the learning environment foster the process. An important assumption of the LES Model is that this style of learning is more effective than one in which students simply wait for someone or the textbook to tell them exactly what to do or how to do it.

The above premise is at variance with the underlying assumption of the most common practice for teaching mathematics. The familiar "show and tell" strategy assumes students need only listen, watch and practice to be become effective problem solvers. When evaluating or selecting an instructional strategy to be used in teaching mathematics by the LES Model, an essential question to ask is what portion of a lesson each student is actively engaged and with what mathematics?

Structure and Organization

To create a learning environment which satisfies the content goals and assumptions of the LES Instructional Model, an activity is structured in three phases known as the Launch, Exploration and Summary. Each phase has distinctive purposes and characteristics. The Launch prepares students to work on the major challenge which is the task for the Exploration phase. Data and experiences from the major challenge are used to search for and apply patterns in the last phase, the Summary. Both the Launch and Summary are taught in a total class mode with the teacher orchestrating the interactions. Almost any style of teaching could be said to fit this structure, but the requirements of the LES Model extend far beyond the skeletal frame of an activity. A more complete characterization follows for each phase.

LAUNCH. During the Launch students are introduced to new concepts and ideas and reviewed on necessary but previously encountered ones. Whenever possible new concepts are expressed through stories which rely on more familiar language and settings. More formal mathematical terms and definitions are generally delayed until after the students have had an opportunity to grasp the general ideas. Along with the introduction or review of concepts, students should be asked to demonstrate their understanding by performing a task or solving a problem.

The second and essential component of the Launch is the mini-challenge. The function of the mini-challenge is to model both the task and directions for the major challenge, the primary task of the Exploration phase. Verbal explanations and directions are simply not as effective in communicating this information as having students attempt the same or a simpler version of the major challenge. Inadequate attention to the mini-challenge inevitably results in numerous questions from individuals who are unsure of how to proceed. These are unnecessary, nuisance questions which result in wasted time, time students should be using to complete the major challenge. A verbal launching of the major challenge signals the end of this first phase.

EXPLORATION. Students work to solve the major challenge during this second phase. Interaction between students enriches the learning experience because of the help and challenge students are able to give one another. Grouping students helps facilitate such interchange. Experiences suggest students work well in groups of 3 or 4 unless the activity requires students to work in pairs.

Because of the normal diversity in students, they do not all finish a major challenge at the same time. Students who finish ahead of others are ready for an extra challenge. As the term suggests, an extra challenge seeks recognition and application of ideas that have not yet been formally examined in class but can be abstracted from the major challenge. Students are intrinsicly rewarded for working on and figuring out the extra challenges. For students capable of solving them, the extra challenges are preferred to the boredom of doing more of the same type of problem or doing nothing. The Exploration phase comes to an end when almost all students have completed the major challenge.

SUMMARY. For the Summary phase students return to the total class mode to clarify the mathematical ideas imbedded in the major challenge. Results are gathered and displayed to facilitate the search for patterns. Since incorrect information is quickly disputed by students, it is the search for patterns and not the checking of answers that receives the most emphasis. Conjectures and descriptions of patterns need to be verified or disputed with the available data. Once new rules, relationships or strategies have been established, students need to apply them in new situations. Thus, the learning experience is extended with additional problems and questions at the close of the activity.

Unlike the sequence in which the phases are taught, the design of an activity begins with the identification of (1) the mathematics goals -- the desired concepts, relationships, rules and strategies, and (2) the major challenge--the task from which these mathematical patterns are to emerge. With the major challenge defining the Exploration phase, concern needs to be given to the way in which data is to be displayed and patterns are to be detected and elicited in the summary. The Launch is the last phase to be planned. Decisions on how concepts are to be presented and what constitutes the mini-challenge are equally important as the Launch sets the state for the second phase. The dependency of one phase on another continues as a successful Exploration is necessary for a successful Summary.

<u>Teaching Techniques</u>

Teaching techniques appropriate for the Launch, Explore and Summarize phases are techniques which seek to maximize student involvement. Both the time in which students are actively on task and the number of students involved are to be maximized. Many of the more commonly used teaching behaviors such as explaining, demonstrating and telling are less effective because students can more easily remain passive watchers and listeners. Although teaching techniques are described by instructional phases, many of them are general in nature and easily apply to more than one phase.

LAUNCH. When introducing new ideas or reviewing old ones during the launch, it is essential that students be asked to demonstrate their understanding as quickly as possible. Once a concept is communicated, through story form or by name, every student should be asked to apply it. Student efforts are readily apparent when concrete materials are in use, somewhat less apparent when responses are written, and even less so when only mental thought is required. Fortunately, another good indicator of students' involvement is the eagerness with which they seek to respond.

Teachers' reactions to the responses students give to their questions are also important. For example, when a student answers a question and the teacher rewards, corrects, or probes this same student, the interchange is only between the two individuals. More student involvement is generated when the teacher refrains from giving immediate feedback about correctness and, thereby, shifts more of the responsibility to the students.

Playing "dumb" for a few moments encourages more students to offer opinions and discourages their looking to the teacher for a judgment, whether verbal or nonverbal. When there is no obvious concensus among the students or when different answers are not immediately forthcoming, ask if anyone has a different answer or if they agree. It is also unwise to identify the student who is to answer a question until after it has been asked. Give all the students a moment to think or try before selecting the respondent.

Students benefit from verbalizing the mathematical ideas they are learning, questions which elicit verbal descriptions also need to be incorporated.

Both the Launch and the Summary need to be conducted at a relatively fast-pace. Since interchanges with individuals can interrupt this fast pace, personal contacts are best avoided or delayed. A common dilemma for teachers, particularly during the Launch, is the student who "doesn't get it". The natural tendency is to stop and help such a student. Unfortunately, interruptions of this type leave other students with nothing to do which, in turn, leads to off-task behaviors and disruption of the flow. The point is to notice how students are responding and encourage effort and contributions from all members of the class, not to engage in isolated interchanges with individuals. The appropriate time for personal attention to students is during the Exploration phase.

Individuals can often be helped without destroying the pace of the lesson. Seeing what someone else did or hearing how others verbalize a mathematical idea or explain a procedure may be all that is needed. Capitalize on incorrect responses as well as correct ones. These are opportunities for learning, not experiences to be prevented. And, if an individual does need help, a brief delay until the second phase will not make all that much difference.

Throughout the Launch a teacher needs to notice how students are responding. When a number of students in the class are obviously struggling with an idea or task, continue posing more problems or questions until there is a sense of success. Decisions concerning the exact number of problems for students to try must remain with the teacher. No script can anticipate and cover all possible situations. There must be some give and take with regard to the number of examples given and questions to ask as well as the amount of emphasis given to certain information. The key to flexibility, however, is sensitivity to student performance and knowledge of the mathematics to be learned.

EXPLORATION. During the Exploration phase the teacher needs to move about the class. Staying in any one place or with any particular students too long could be unwise as there are a number of roles to be assumed. First is the task of monitoring what students are doing, even if they are all successfully engaged on the major challenge. Unexpected or varied ways in which individuals perform a task is informative. Other tasks for the teacher during this phase require maintaining, helping and extending behaviors.

Maintaining behaviors are the things teachers do to keep students on task. Attention to students progress is the primary goal. Commenting on their progress, challenging particular responses, checking to see how many examples have been found, and the like are techniques which help keep students focused on the task.

Helping behaviors are used with students experiencing difficulties. Since it is important to find out what such students are thinking, simple questions such as, "Can you show me how you got that?" are often enough to determine where help is needed. Teachers need to avoid remaining so long with an individual that other students are neglected. They also need to avoid any propensity to simply tell or show a student how to do something rather than to find the source of difficulty by asking questions. As the nature of misunderstanding becomes clear, the information needed may also.

Teachers are not the only source of help during this phase; students in the same group are often quite helpful to one another. Because learning is a social as well as a private activity, verbalization and interaction about ideas is one of the purposes of grouping students for this second phase. Unfortunately, the danger of helping by telling applies to students as well as teachers.

SUMMARY. Many of the comments about the Launch apply to the Summary phase, as it is also conducted at a fast pace through total class instruction. Tasks for the teacher in this phase include gathering and displaying data, and seeking, verifying and extending patterns. Results of the major challenge should be elicited and displayed quickly and efficiently. Since the purpose is to seek patterns, the data also need to be arranged to best reveal the patterns of interest.

When conjectures are offered make an effort to see they are heard and understood so they can be verified. While some conjectures are best left to verbal description, others are best shared in symbolic form. Rules whould be written in a manner which reflects what students are doing and saying. If, for example, they report finding perimeter by summing the bottom and side edges and then doubling them, the rule should be written as $(B + S) \times 2 = P$ and not the more conventional $P = 2(B + S)$.

Flexibility is important as students may offer unanticipated suggestions and may miss some critical conjectures. An honest examination of almost all suggested patterns demonstrates a valuing of student ideas. Some patterns can immediately be recognized from the display while others need to be verified. Focusing students' attention on certain patterns is handled through verifying and extending moves. Asking students to verify a pattern from selected examples and obtaining agreement helps to identify it as important, as do questions which ask students to apply the new patterns to new problems. Since individuals offer conjectures, student involvement is increased by asking everyone to verify a pattern or to try a new problem.

Student diversity comes through in other ways besides the obvious differences in time and effort needed to complete the major challenge. One is in the recognition and reporting of patterns. Another is the inclination or lack of it to use patterns which emerge during a summary. Just because students have reported a rule does not mean they will use the rule the next day. Students often rely on a more primitive approach for quite a long time. Skills are acquired at varying rates.

Helping students make the transition from a concrete or more primitive approach to a more formal or rule governed behavior often takes time and additional effort. Although extra reviews are not generally written into the scripts of the MGMP units, teachers may find it necessary to incorporate an occasional review. Since it can never be the case that all students learn at the same rate, acceptance of the variability is essential. The goal is not to ensure that all students are peforming at the same level, but that each student has some way to perfom a task that makes sense to that student. Reviews provide additional opportunities for students to retain and possibly extend what they have learned, as do follow-up assignments from textbooks.

To teach successfully with the LES Instructional Model means to retain the integrity of the model's mathematical goals, assumptions about learners and learning, structural criteria, and valued teaching techniques. While the type of learning environment produced by this approach is needed in the mathematical experience of every student, not all lessons can or even should attempt to comply with the LES Model. Finding and recognizing appropriate content and tasks is but the first step to incorporating such activities into a teacher's normal routine. Teaching the MGMP units is another valuable step in learning how to implement the LES Model.