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ABSTRACT

There are many learning opportunities in the science curriculum which emphasize creativity. Learning opportunities are described in this paper which involve: (1) problem solving experiences; (2) poetry reading and writing; (3) prose and its applications in creative endeavors; (4) art work as creativity in science; (5) creative dramatics and famous biographies of individuals in the world of science; and (6) construction experiences to achieve objectives of student creativity in the science curriculum. (KR)

CREATIVITY AND SCIENCE

Marlow Ediger

Creative endeavors are needed for students. Unique content coming from students emphasizes the learner and the curriculum being integrated, not separate entities. The science curriculum can then make many contributions in guiding creative development for students. Pertaining to students making discoveries, Lipman, Sharp, and Oscanyan[1] wrote:

> So it is with children. The meanings they hunger for cannot be dispensed to them the way wafers are dealt out to communicants at a mass; they must seek them out for themselves, by their own involvement in dialogue and inquiry. Nor is that the end of the matter, for meanings, once found, must be cared for and nurtured, as one might care for one's house plants, pets, or other living and precious treasures. But the children who cannot make sense of their own experience, who find the world alien, fragmentary, and baffling, are likely to cast about for shortcuts to total experiences, and eventually may experiment with drugs or succumb to psychoses. Possibly we could teach children before they reach out for such desperate remedies by helping them find the meanings so lacking in their lives.

Problem Solving, Creative Behavior, and Science

Students in the science curriculum need to receive quality activities and experiences to achieve the broad goal of revealing creativity in the school and class setting. Creative beings are very much needed in school and in society. Thus problems need identification and novel solutions needed. The tried and true, as well as the traditional, too frequently do not work in solving vital problems. Which learning opportunities might then assist students in science to achieve the overall goal of developing the creative being?

From an ongoing science experiment, students might be encouraged to identify questions and problems. Each should be recorded on the chalkboard or transparency. Value judgments should not be made as the questions/problems are selected. Rather, generating of ideas is salient. From the listing, students individually or in committees may select an area to pursue. Students then with science teacher guidance may choose that which is perceived as being important. For example, if the performed science experiment pertains to changing selected solids to liquids, students in the ongoing unit could raise questions such as the following:

1. Why do these solids (diverse kinds should be in evidence) change to liquids at different temperature readings?
2. What happens when solids change to liquids?

Questions raised will depend upon the developmental level of the involved student. The above are given as examples. For each question raised, answers need to be sought using diverse reference sources. Students may work individually or in committees to find needed information. With student-teacher planning, the former may have much input into seeking and selecting the references sources. Experimentation and demonstrations, among other activities, may as learning activities, guide students to find needed answers to identified questions. An open ended approach is in evidence for students to select reference materials.

From the data gathered, students may brainstorm hypotheses or answers to identified problems. Selected hypotheses may be tested to notice their quality and objectivity. If the hypothesis needs revising, a discussion may follow to make modification and changes.

Pertaining to experimentalism as a philosophy of education, Ozmon and Craver[2] wrote:

> According to the pragmatists, education should be an experimental enterprise as well as something that assists in social renewal. It should promote a humanistic spirit in people, as well as the desire to explore and find new answers to our present-day problems in economics, politics, and other social life. Education should promote our true individualism that will result in a diminishing of our reliance upon custom and tradition in the solving of our problems, and cause us to rely more upon intelligence to achieve our goals and interests.
>
> Dewey pointed out that a "philosophy of education" is not the application of ready-made ideas to every problem but rather the formation of right mental and moral attitudes to use in attacking contemporary problems. Philosophy itself is "the theory of education in its most general phases." When changes occur in social life, we must reconstruct our educational program to meet these challenges. Thus, our ideas will have a pragmatic function. Learning helps us to meet environmental changes and affects our character as well. In this way, education has a moral influence and should play a vital part in helping us to become the kind of moral persons who are interested not only in promoting our own growth, but also in promoting the growth of others.

Poetry, Creativity, and Science

Enjoying and writing of poems can certainly emphasize creative endeavors for students. The science teacher may read orally selected poems to learners relating to the unit being taught. Poems need to be chosen on the basis of the following criteria:

1. Will each poem capture learner interests?
2. Will students attach meaning to the poem?
3. Will individual differences be adequately provided for?

The science teacher should also introduce selected poems in a stimulating manner to encourage students to read the content on their own. A bulletin board display of poems, attractively arranged, may well

encourage students to do more reading of poetry related to the ongoing science unit.

Readiness experiences for poetry writing may come from experimentation, audio-visual presentations, and/or reading activities in the science curriculum. Types of poems which students may write include:

1. couplets -- two lines with ending words rhyming.
2. triplets -- three lines with rhyme in all words at the end of each line.
3. quatrains -- four lines with diverse patterns of rhyme, such as lines one and two, as well as lines three and four rhyming.
4. limericks with rhyme in lines one, two, and five, as well as in lines three and four.

The above named poems contain rhyme. Free verse contains no rhyme and does not adhere to any specific number of lines needed within the poem. Also, students with science teacher assistance need to be introduced to writing poems emphasizing syllabication when readiness is in evidence. The following poems may then be read to and written by learners in ongoing science units:

1. haiku with its five, seven, five syllables for each of three lines of verse.
2. tanka with its five, seven, five, seven, and seven syllables for each line of poetry.
3. cinquain with its two, four, six, eight, and two syllables respectively per line in a poem five lines in length.

To emphasize enthusiasm in the writing of poems in the science curriculum, students should experience

1. onomatopoeia or echoic sounding words in the written product.
2. alliteration, another poetic device, emphasizing two or more sequential words starting with the same phoneme or sound.
3. imagery in which creative comparisons are made, such as "the moon looks like a smiling face." Here moon is creatively compared with a smiling face. The word like connects the two above underlined words. If the words "like" or "as" make the connections, a simile is in evidence. Otherwise, the creative

comparison is a metaphor, e. g. the moon is a smiling face above.

Creativity as an objective might well be achieved by students' writing poetry directly related to facts, concepts, and generalizations achieved in an ongoing science unit.

Prose, Creativity, and Science

Students should experience prose from selected library books directly related to the present science unit being taught. An interesting type of prose for teachers to introduce and read to learners is tall tales. Readiness activities are then being provided students to read tall tales.

Inductively, students can generalize as to what makes for a tall tale. The following are its characteristics:

1. a superhuman being is necessary. Paul Bunyan and Pecos Bill in American tall tales exemplify the superhuman concept.
2. the superhuman gets into one or more difficult situations.
3. the superhuman being is able to get out of the prescribed difficulties.

Students could take a famous scientist and develop a related tall tale. Students need to be imaginative, possess openness to new content, like being playful with ideas, exhibit tendencies of fluency of thought, as well as pursue a poem to its completion in writing.

Writing tall tales present opportunities to the student to relate the science curriculum to a truly open ended kind/type of creative endeavor.

Art Work in Science

Creative experiences may certainly be emphasized in correlating science and art. The writer when supervising a student teacher in the

public schools observed a well done mural on prehistoric life, a science unit. The student teacher developed, planned, and implemented the unit in science. One activity emphasized a committee of sixth grade pupils developing the prehistoric life mural, utilizing a variety of art media. In the mural, students portrayed the following scenes:

1. a tyrannosaurus rex dinosaur attacking a stegosaurus.
2. a brontosaurus situated in a body of water eating plants.
3. an archeoepteraux flying overhead.
4. fern plants growing in abundance.

Pupils with student teacher guidance evaluated the mural in terms of:

1. effort put forth by each learner.
2. input from all committee members in developing and completing the mural.
3. new ways of presenting subject matter in art form.

Prior to developing the mural on prehistoric life, the science teacher:

1. showed and discussed a related filmstrip.
2. presented and appraised illustrations.
3. provided readiness for students to read from their basal science textbooks. Facts, concepts, and generalizations secured by learners were discussed with teacher leadership.

Additional art projects developed by committees in the unit on prehistoric life were the following:

1. papier maché models on the diplodocus and the anklasaurus.
2. clay models of duck billed dinosaurs.
3. a diorama containing a three dimensional scene, in an enclosed box with the front open, showing diverse dinosaurs with a natural environment for its day in prehistoric times.

Students need encouragement and reinforcement to develop feelings of creativity and spontaneity.

Creative Dramatics and Science

Numerous opportunities are available for learners to participate in creative dramatics in ongoing science units. In a unit on "Famous Scientists," the science teacher needs to guide students to secure background information pertaining to famous scientists being studied. Reading and audio-visual activities should provide readiness experiences for learners.

Students may then be divided into committees. Each committee needs to plan roles for members to play as famous scientists being studied in the ongoing science unit. Famous scientists to be included in the unit and from which students individually will have parts for the creative dramatics presentation could include

1. Louis Pasteur.
2. Anton Leuwenhoek.
3. Joseph Lister.
4. Sabin and Salk.
5. Pierre and Madame Curie.

The above named scientists are given as examples. Goals need to be clear for students to achieve in creative dramatics. Background subject matter obtained and the creative dramatics presentation in and of itself need to be appraised in terms of stated goals. Students should be involved in self-evaluation endeavors. Creativity is the major goal for students to achieve in the dramatic activity. At the same time, relevant subject matter needs to be achieved by students.

Construction Activities in Science

Students might well reveal creative behavior through constructing items and objects in the science curriculum. Individual or committee

endeavors may be emphasized here. Each project constructed needs to show a carefully thought through purpose. Thus, a student perceives reasons for the construction activity. Then the purpose or goal needs to be planned by students with science teacher guidance. Here, a psychological sequence is involved in developing the plans for constructing and making. The learner does the sequencing in a psychological science curriculum when planning to attain the inherent purpose.

After planning, the actual carrying out of the plans is involved. Each ordered sequential step needs to be implemented. Application is involved when the planning is carried out to completion. The final process is to appraise the project utilizing quality standards. Input from the student is needed to appraise the worth or value of what has been constructed.

Depending upon the science unit taught, many construction activities can be completed by learners on their present level of readiness. The following, among others, in a unit on "Our Changing Weather" could be appropriate:

1. hygrometers.
2. thermometers.
3. rainfall gauges
4. barometers.
5. wind vanes.
6. anemometers.

In Closing

There are many learning opportunities in the science curriculum which emphasize creativity. Among others, the following might well be salient:

1. problem solving experiences.
2. poetry reading and writing.
3. prose and its applications in creative endeavors.

4. art work as creativity in science.
5. creative dramatics and famous biographies of individuals in the world of science.
6. construction experiences to achieve objectives of student creativity in the science curriculum.

Pertaining to creative writing and utilization of trade books, Gega[3] wrote:

> Here are some ideas for creative writing that you can use repeatedly with different trade books.
>
> Diary. Write an entry from an event in the life of George Washington Carver, Marie Curie, and so on ("February 18, 1897. Is it impossible? I have now tried dozens of ways to ...")
>
> Letter to a famous scientist from the past or present ("Dear Dr. Einstein:")
>
> Interview with a famous person ("What was it like being an astronaut, Mr. Glenn?" "It had its ups and downs, Sally," he said with a grin.)
>
> Future autobiography ("An exciting page from your life in the field of _____!")
>
> TV or radio script: "You Are There!" (Reenactment and report on the first moon landing, first colony on the moon, development of the first human clone, first successful brain transplant, peaceful visit to earth by creatures from another planet, discovery by junior scientists from room 6 of the languages used by dolphins, chimps, dogs, and so on, and what they have been waiting so long to "tell" us.)

Selected References

1 Lipman, Matthew, Sharp, Ann Margaret, and Oscanyan, Frederick S. Philosophy in the Classroom. Second edition. Philadelphia: Temple University Press, 1980, page 7.

2 Ozmon, Howard and Craver, Samuel. Philosophical Foundations of Education. Fourth edition. Columbus, Ohio: Merrill Publishing Company, 1990, pages 139-140.

3 Gega, Peter C. Science in Elementary Education. Sixth edition. New York: Macmillan Publishing Company, 1990, page 106.