

The Distinctive Place of Induction
in Education.

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Introduction.

1. Explanation of terms in the title.
2. History of the development of the method.
3. Nature, characteristics and general problem of induction.

Development of the subject.

1. Place of induction in the Kindergarten.
 - a. Play of children.
 - b. Observations of teacher.
2. Place of induction in public schools.
 - a. Use in teaching reading.
 - b. " " " physiology and hygiene.
 - c. " " " history.
3. Place of induction in oral teaching.
4. " " " " higher schools.
 - a. Use in teaching chemistry.
 - b. " " " physics.
 - c. " " " botany.
 - d. " " " literary subjects.

Conclusion.

1. Place induction will occupy
in the future.

Induction as used in this instance refers to that process of reasoning in which the observation of individual or particular instances and the inferences drawn from these observations to form generalizations is the method followed. By its place in education is meant the part induction plays in the passage from old knowledge to the new, or from individual truths to general laws.

Active knowledge-getting is the idea conveyed by the word education and not accidental information which comes without one's personal effort.

This method of instruction is one of peculiar interest and importance to all who are engaged in assisting young persons in acquiring an education and forming correct mental habits. It even holds an important place in every day life

because it treats instances of common experience in an analytical manner.

Inductive inquiry had its beginnings in the fifth century before Christ when Socrates developed his method of questioning people in order to draw them out and lead them to make discoveries for themselves. This method was limited in its application however at that time to questions of correct conduct. Plato continued the work of Socrates and also succeeded in broadening the field of work by using the method in refuting the intellectual scepticism of the Sophists.

In the sixteenth century the man who stands pre-eminent as a promoter of the inductive logic as a method of making discoveries in science is Francis Bacon. The

old use of induction had simply been to verify - and show the certainty of the knowledge already discovered. Carefully planned experiments formed a part of Bacon's method - and great emphasis was laid upon the necessity of following a system in making observations, either from experiments or from nature. Bacon showed in his writings that the source of all knowledge begins with facts of perception. It is recorded in history that he is the true founder of the inductive sciences of nature.

The natural sciences advanced greatly during the seventeenth and eighteenth centuries, but no effort was made to investigate the method employed until Sir John Herschel attempted an explanation. The rise and perfection of the natural sciences

as a means of education has come however in the latter half of our own century.

The man who did most towards placing the study of logic on a new basis was the great English logician John Stuart Mill. He fully believed that induction was the only means of arriving at new knowledge. Many writers of today devote much more space to the inductive form of logic than they give to the deductive form.

It is the nature of induction from the point of view of reasoning to deal with concrete instances. The end which it has in view is to discover from the observation of cases, which have points of resemblance, a generalization or law of universal application and continuous validity.

As an illustration of the nature of inductive inference and a conclusion drawn from the same may be noted the following example: two bodies of unequal weight, for instance a dollar and a piece of paper, are suspended at the same height under the receiver of an air-pump which has been exhausted. Upon releasing them they are observed to fall to the bottom in the same length of time.

From this the inference can be drawn that if the experiment were repeated, either with the same or different bodies, a like result would follow, -and that if it were not for the resistance which the atmosphere or other hindering causes offer, -all bodies no matter what their weight would fall through equal distances in equal

amounts of time. The noticing of this fact is a simple case of observation but the conclusion that they or any other bodies would do likewise under similar conditions is an inductive inference.

Some of the characteristics of the inductive method should be known in order to recognize the process when we confront it. One of the first points to be noted is the basing of every system of induction on the supposition that facts of true logical meaning may be collected by the observation of the investigator. In following the method of inductive reasoning we are supposed to be at liberty in the world to gather our own facts, which in all cases are individual occurrences. From the combined results are drawn the universal laws.

A second characteristic is the recognition of change and the bearing which the variation of one event has upon another.

The third characteristic of importance is the inclination to act on the assumption that in the change of events there will be a certain regularity. The fourth characteristic distinguishes what is known as the "critical stage" in induction.

When the process has reached this point the observer attempts and, sometimes with much earnestness, to examine each case of a given class in the territory - available to him.

Of course every sane person knows that this is an ideal situation impossible to reach, but to strive for it is much gain.

The general problem which every teacher should seek to solve is the problem of how to use the methods of inductive

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thinking in enabling pupils to pass from the stage of observation of confused facts to the orderly arrangement of real knowledge.

The first place in which the teacher has an opportunity to use the inductive method in the education of the child is found in the kindergarten. The education that a child receives there is not that of book knowledge, but to the little individual is many times more valuable if properly conducted.

As the inductive method proceeds upon the plan of observation of facts followed by their explanation - and the development of general notions, the teacher can pursue it both in learning how to teach those under her care and in teaching them how to

learn. A kindergarten teacher must observe children at play in order that she may know the games in which they engage and how they play them.

In studying the play of children the teacher can determine the needs of each case, and by skillful efforts guide the child in learning new amusements. The play of a child should be varied so that an all-around development of physical powers will be acquired. In watching different children as they grow a teacher can conclude what would be applicable in giving a full development to other children under similar circumstances.

Many a child has shown in his play glimpses of the profession which he is best suited to follow in his

mature life. Some children do not even know how to play. On being given an opportunity to see others engaged in games they will acquire the art, but if the teacher should tell them to play "doctor" and they had never witnessed the amusement it would be hard for them to grasp the idea. A little illustrating would be a great help.

By carefully guiding children in their play they will learn many useful things which lead up to work and yet never be realized by them. Educating children to play usually takes away some of the spontaneity of their acts but if the method of teaching from concrete individual instances is followed then the general notion of what it

means to play is easily obtained.

When children pass from the play-school into the rest school and begin to use books, the question of how to teach them to learn in the easiest and best way arises. Most children have learned at home the letters of the alphabet so that the first thing to do is to teach them to read. A teacher can easily get many familiar objects and have the children learn the names of them. Then by writing these names on the blackboard or showing them the words in their readers, the picture of the object and the word which stands for it become firmly impressed upon their minds.

Then from the knowledge of a few particular names of familiar

objects the child acquires the idea and power of learning other words. Questions aid in learning the action and quality words. But the teacher must be sure to begin with that which the pupil knows and by showing the relation between the pupil's knowledge and the unknown teach the unfamiliar words.

Children learning to read should be taught other things besides reading, but at this age they should never be forced as forcing will make dullards of them. To vary the monotony, both for the teacher and pupil, ask geography questions about their father's farm, or the home school district, or if the school is in the city ask them if there is a river near and its name, or have them tell of visits to the city park.

Find out what they know and lead them to observe, Thus they will gain new knowledge. The belief in inductive work has partly led to the emphasis which has been laid lately upon home geography.

With children a little more advanced but just beginning the study of physiology and hygiene the inductive method can be employed to great advantage. If taught the care of the teeth, eyes and ears, proper habits of food, sleep and ventilation and things that will appeal to each child personally, their interest will be aroused in studying and developing general laws of health.

This will prepare the way for the later study of the anatomy of the human body. To teach this charts and a manikin will be found helpful. Although

no man-made form can ever approach with accuracy that creation of divine power, yet by studying the parts separately in illustrations the general notion will be made much more vivid and clear.

Another subject to which the method in question can be applied successfully is that of history. Pupils do not comprehend the full significance of a great many valuable lessons, as, when a teacher says for example, "Now we will the principle that in union there is strength." Consequently there is manifested a lack of interest. On the other hand if a teacher would say, "While we are studying the formation of the colonial governments, the adoption of the Articles of Confederation, and finally of the constitution let us observe what great principle is illustrated,"

each child would be filled with enthusiasm and interest for his lesson and when the study was finished would realize the application of the illustration to the principle. Many more examples could be given of the place of induction in the work of education in the graded schools, but a few words are necessary on the subject of the use of the inductive method in oral teaching before its place in advanced education is discussed.

By oral teaching is meant teaching without a text. It is often necessary for a teacher to give information on subjects which are not treated in school books, or to find out what the pupils know on such subjects. Every child should have inculcated in his nature a love of the truth, a love for his country, a knowledge of how to do right, respect for

elderly people, and reverence for things sacred. This work can be done every day in little asides and the pupils will never realize whence it all come. A little story one day, a kindly another, a firm reproof of some pupil's careless act all tend to build up a character strong in the above attributes.

For this work the inductive method lends itself admirably. Because if a child is told to do a thing directly, his antagonism is almost sure to be aroused. Lead him to think it is the natural thing for him to do and he will do it gracefully and cheerfully.

Sometimes it is necessary for the teacher to arouse an interest in a subject now uninteresting, not alone by means of charm and skill, but by showing how it furthers the ends

in which the pupil is already interested.

This is interest aroused by induction and is more efficacious in higher than in lower education. When one memorizes rules and definitions not yet understood he is led to substitute mere words for ideas. This is a foolish practice, so students should be helped to make sufficient particular observations to insure the correct interpretation of the rule.

For students in the high school beginning the study of physics, chemistry, botany and similar sciences much observational and experimental work is necessary to give a clear understanding of the laws involved. One of the first things to be learned in chemistry is the difference between a compound and a mixture. A clear understanding

of the difference is best attained by letting the pupils examine, first a mechanical mixture, then if it is possible change it into a chemical compound - and let them examine the latter, noting the points of difference. Sulphur and iron filings are convenient articles to use. After observing this - and possibly a few more particular cases, students are soon able to state a definition for each.

Under the topic the nature of induction was given an illustration of the use of this method in physics.

In botany there is unlimited room for the use of the inductive method. Laboratory work is most productive of knowledge when the student takes up the study of a plant as an individual. Then as he studies the individuals

like points will enable him to classify them - and thus he will gather the general notion of each group and the laws of plant environment. Regular class work can be carried to a certain degree inductively, but this is not so necessary nor can it be made so extensive as the laboratory method.

Literature and the allied subjects do not lend themselves so easily to the method of induction, yet it can be used very profitably, especially in teaching the lessons drawn from the text.

It seems as though it ought to be hardly necessary to set forth an argument in favor of the use of induction as a method of teaching, for its excellent qualities show so plainly that one cannot help but recognize them.

However this method is not used at the present time nearly as extensively as it might be. One reason for this may be because it is harder to teach by the inductive method and requires more time. Now text-books following the inductive method are being introduced into the schools and this will make teaching by it easier.

If instructors fully realized how much they could accomplish by teaching from the particular known topics to the general uninvestigated truths, surely the inductive method would be more widely used. But the progress of the race has been inductive and experimental according to McMurry so that probably the day will arrive when educational methods have become

so complete that the inductive
method will be universally used.