LANGUAGE LEARNING AND A SEARCH FOR A THEORY. AN ATTEMPT AT A METHODOLOGICAL ANALYSIS OF THE COGNITIVE GRAMMAR TEACHING SEQUENCE

ANDRZEJ ROGOWSKI

Adam Mickiewicz University, Poznań

1. The aim of the present paper is to point out certain similarities between the scientific procedure and the process of language learning and find out the sources of these similarities. We will also try to classify a certain set of grammatical exercises and a certain type of presentation as a specific method of scientific inquiry. As we are going to deal with two seemingly unrelated phenomena — language learning and scientific procedures — it seems necessary to start our discussion with a brief account of the bases for associating language pedagogy with the methodology of science.

It seems reasonable to claim that both language pedagogy and the methodology of science are, roughly speaking, concerned with similar problems — with ways of acquiring systematic knowledge. Both have a prescriptive and a descriptive function and deal in their analyses with similar basic and "idealistic" in nature elements:

Language Pedagogy	language	student	knowledge (skill)
Methodology of Science	science	scientist	knowledge (truth)

This correspondence between language pedagogy and the methodology of science stems from the fact that learning a language is a kind of scientific cognition. In the language teaching process the student "collects" language data and processes this information, thus contributing to enlarging his knowledge of the target language. Similarly, in the scientific process the scientist transforms available data thus contributing to the development of science. Therefore, in my opinion, all approaches to language learning are based on certain theories of scientific process which attempt to establish a structure of actual cognition.

Let us point out also that from a formal point of view language pedagogy and the methodology of science have much in common. Language pedagogy in the narrow sense deals with methods of learning/teaching a language. On the other hand, language pedagogy in the broad sense is concerned with the whole process of learning/teaching, including its principles, characteristics, results, etc. As the process itself is extremely complex, studies in the fields of linguistics, psychology, pedagogy, sociology, and others, are necessary and significantly contribute to the development of research in language pedagogy. Although the division into language pedagogy in the narrow sense is seldom met in theory, it seems that such a differentiation reflects the actual state of affairs.

And similarly, the methodology of science in the narrow sense, often called the logic of discovery and justification, deals with the analysis of scientific inquiry and its methods. The science of science, i.e. methodology in the broad sense, is concerned with the process of scientific inquiry itself (methods of achieving knowledge) and its results (structure of knowledge). It also makes use of studies of psychology, history, logic, sociology, etc. (Such 1969).

The relation between language pedagogy and the methodology of science can be presented in Table 1:

TABLE I

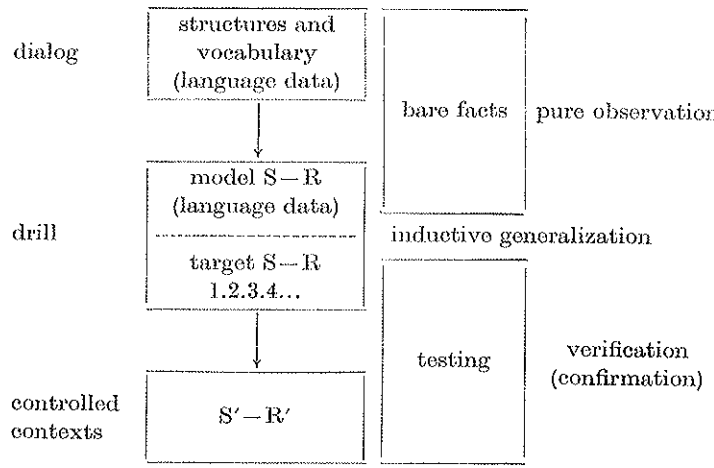
	LANGUAGE PEDAGOGY	METHODOLOGY OF SCIENCE	
LANGUAGE PEDAGOGY IN THE BROAD SENSE	language pedagogy in the narrow sense	language (system)	science (system)	methodology of science in the narrow sense — METHODOLOGY OF SCIENCE IN THE BROAD SENSE
		student (actor)	scientist (actor)	
		process of learning	process of scientific inquiry	
		LINGUISTICS	LOGIC (structure of science)	
		PSYCHOLINGUISTICS	PSYCHOLOGY OF SCIENCE	
		SOCIOLINGUISTICS	SOCIOLOGY OF SCIENCE	
		'HISTORY' OF LANGUAGE PEDAGOGY (history of methods, data concerning language acquisition and learning, experiments, etc.)	HISTORY OF SCIENCE AND TECHNOLOGY (data)	
		PLANNING AND STATISTICS (syllabuses, tests, etc.)	ECONOMICS (planning)	

If the above claim is true, i.e. that language pedagogy is a particular kind of the methodology of science and learning a language is an analogue of scientific cognition, then it follows that, for instance, the audio-lingual and the cognitive approaches to language learning are based on two distinct concepts of scientific inquiry. And, consequently, certain methods of teaching impose on the student certain procedures of learning which, when analysed from the methodological point of view, specify the concepts of growth of knowledge that underlie the approaches to language learning.

2. Let us now briefly analyse the student's procedures in a typical audio-lingual class from a methodological point of view. The student is first faced with *bare facts*, i.e. pattern practice dialog and all its structures and vocabulary. As he is by no means expected to interpret the language data he observes into a rule that governs their occurrence, he makes preliminary *inductive* conclusions that are based on *pure observation*, i.e. the ones that do not go beyond facts. Then he participates in pattern practice drills. Now the data from the dialog and from the model part of the drill are inductively generalized into a rule which is subsequently confirmed in correct (strictly controlled and automatic) responses to the stimuli (cues).

The whole process consists of three phases: observation of numerous facts of the same type, inductive conclusion that follows from these facts, and inductive testing which is in advance aimed at confirming rather than falsifying the rule under investigation. It can be presented in diagram 1:

Diagram 1



As we can see, the audio-lingual grammar teaching procedures are based on the inductive method of scientific inquiry. It is noteworthy that a large number of *correct* responses are considered by audio-lingual theoreticians to guar-

antee success in learning. This idea clearly corresponds to the inductionists' claim that the more confirmations of their hypotheses scientists can find, the more true and scientifically valuable they are. Thus, in both concepts incorrectness and falsification are considered to impede progress.

3. It seems that the cognitive approach is anti-inductive in essence because:

1. It starts with understanding and not with bare facts, i.e. with the principle (rule) and concept (content), and not with structure (form); it starts with interpretation, not passive observation.

2. It emphasizes creativity, i.e. using the acquired knowledge in new "risky" testing situations which require both mental operations and decision, not merely copy-like responses to stimuli or numerous "confirmations" in strictly controlled situations.

3. It stimulates creative hypothetical thinking and not inductive (automatic) generalizations.

4. It emphasizes the systematic way to the growth of knowledge and not the accumulative one, meaningful and fundamental understanding of the system and its functional implications.

The above affirmative and negative statements express the characteristic features of the anti-inductive and inductive methods of scientific inquiry, respectively.

Let us note that the cognitive procedure is here called "anti-inductive" and not "hypothetico-deductive" although the two are, in fact, equivalent. It seems, though, that the general and often vague descriptions of various cognitive techniques reflect only a critical attitude towards the audio-lingual method and do not provide a complete, fully consistent and competitive pattern of presentation and exercises which could be called "hypothetico-deductive". However, in the following chapter we will describe a certain recently proposed concept of cognitive presentation and exercises sequence and we will attempt to establish whether calling it "hypothetico-deductive" is justified.

4. It is noteworthy that both the positivist and hypotheticist methodologists clearly divide the scientific process into two basic stages: the making of hypotheses and their testing. They are the so-called "context of discovery" and "context of justification" stages. The latter is far more important and therefore should be the central subject of the methodology of science. One of the adherents to this point of view, common to positivists and hypotheticists as well, is Karl R. Popper who claims (1977 : 32), that the logical analysis of scientific knowledge should deal with the problem of Kant's "quid juris?" and not with "quid facti?" Thus, methodological analyses should deal with

justification and testing of hypotheses, theories, etc. and it is empirical psychology that should attempt to solve the problem of making them.

In connection with the above-mentioned division, the problem of the relation between the context of discovery and the context of justification causes some controversies among methodologists (Such 1975). Some maintain that the two are unrelated, some that they are interdependent and others that the division is unjustified because the two contexts operate constantly on the feedback principle (Such 1975 : 13).

In the field of language pedagogy the division of the process of learning a foreign language into presentation and practice, which includes exercises and communication (testing), seems reasonable. As far as the process of the relation between the two stages is concerned, the situation in language pedagogy corresponds to the view that the two are closely related and "any conception of testing or justifying hypotheses has its specific rules or ways of arriving at hypotheses, theories, laws, etc. (Such 1975 : 9). And so, various theories/methods of language learning/teaching most often imply specific interdependent conceptions of presentation and exercises. Such is the case with the sequence of grammatical exercises presented below. It also presupposes a specific type of presentation.

As we are going to classify the exercises in question from the point of view of a certain scientific procedure, let us start the analysis from the first part of the learning process, i.e. the presentation.

4.1. The Cognitive Presentation as proposed by W. Marton* should consist of the following parts:

(1) Advance Organizers
(2) Demonstration
(3) Orientation Practice
(4) Elicitation of the Rule
(5) Formulation of the Rule
(6) Providing Algorithm or Mediator.

Advance organizers (1) aim at helping the students to bridge the gap between the old and the new material — it is the first signal for the students that a certain problem will be encountered. For instance, in the case of introducing the Present Perfect Tense in English, it could consist of discussing those sentences where only one tense, i.e. the past, is used in Polish whereas a number of tenses can be used in English. The presentation proper — Demonstration (2) — consists of a verbal presentation of a rule which is accompanied by acting, showing a picture, etc., writing the key structure on the board and further verbalizing about the situation, e.g. asking and answering questions,

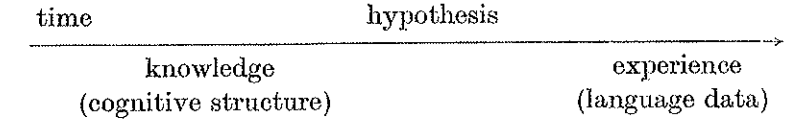
* W. Marton 1977, Lectures at Adam Mickiewicz University, Poznań, 1977.

describing the event, etc. The next stage (3) is basically similar to the second stage except that now the students get more involved in the situation created by the teacher. It is now they who speak — answer questions, describe and talk about the situational context making use of the new structure/rule. Then (4) the teacher tries to elicit the principle; by talking to students he helps them to arrive at certain conclusions which finally result in a joint formulation of the rule (5). The last (6) stage is to help students to understand the meaning and implications of the rule and remember it better. Either the teacher himself or together with students construct an algorithm and/or mediator.

Since it is expected that the formulation of the rule takes place already during the presentation proper, i.e. demonstration, only this part will be analysed. Now we will try to establish what procedure of hypothesis formulation is favored by this type of presentation.

4.2. During the demonstration of new grammatical material as proposed above, the student is supplied with empirical data. The teacher creates a certain situation and by means of verbal behavior, i.e. verbalizing in the target language about what the students can see, implicitly conveys a message which consists of a certain grammatical phenomenon. The whole situation stands for a grammatical rule and it is the students' task to discover it, i.e. formulate the rule in question. Thus, the empirical data are restricted by the topic/grammatical problem and especially arranged so as to optimize the discovery.

It seems reasonable to claim that, if the formulation of the hypothesis takes place in this kind of presentation, it certainly is not an inductive process. First, the empirical data, i.e. acting plus language elements, do not constitute a starting point for the formulation of the rule by the student. In order to perceive the situation in question correctly a certain amount of previous knowledge is indispensable. For example, the student has to know his task, the basic principles of social interaction, etc.; furthermore, he must be able to reason logically. His theoretical background, the cognitive structure, together with experience, i.e. the data he is exposed to, result in the formulation of the hypothesis. Note that in order to magnify the link between knowledge and experience, the latter is preceded by Advance Organizers (1). Therefore, the hypothesis as the result of knowledge and experience is, in fact, prior to the latter:



Second, the hypothesis in question is rather a theoretical construct — a rule of the form "if a then b" — which does not pertain directly to the observed facts. The student selects and associates certain elements from the whole event

and formulates a hypothesis which does not originate from, nor correspond to, pure observation, i.e. bare facts only. It would be very difficult to arrive at a theoretical rule through the generalization of single descriptive observation statements, since the latter in most cases are quite varied: the teacher may use new regular and irregular forms together with the already known ones, questions, comments, etc. The content of the observation statements made by students goes in fact beyond the actual content of observation — the demonstration thus appeals to theoretical and not observational knowledge. For example, in the case of introducing the Present Perfect Tense the students probably make the statement:

"appropriate forms of *have* are put before verbs with the *-ed* ending"

although the actual observation statements should be:

"the teacher said: *I have put the book on the table*",
"the teacher said: *John has just painted a picture*",

and the like. The process here is the changing of observation statements into scientific ones (Popper 1977), which is characteristic of hypotheticism. Therefore, the extraction of the rules/principles requires a certain degree of heuristics and interpretation. The hypothesis itself is theoretical rather than observational in nature and thus it is not directly connected to experience.

To sum up, the observation is here governed by the problems that are intended to be solved. The student's way of perceiving the experience is very strongly influenced by the fact that he is concentrating on his task, i.e. finding out the rule. The results of observation are always interpreted in the light of certain theories, i.e. the student's cognitive set-up and "previous knowledge". Thus, it seems that the type of presentation described above favors a hypothetico-deductive formulation of theoretical hypotheses rather than automatic inductive generalizations of observed facts into an observation law.

The latter conclusion seems the more justified because the type of hypothesis formulation as presented above negates the three basic theses of inductionism:

(1) The thesis of methodological empiricism which says that all our knowledge about the world comes from experience and experience is its only confirmation;
(2) The concept of science as a purely descriptive activity which states that objective cognition of the world is genetically based on pure experience, i.e. the observation of bare facts;
(3) The thesis of the passive role of the mind in cognition which claims that the mind works best if it completely lacks a priori expectations which do not refer directly to reality (Giedymin 1966: 272).

It seems that none of the three theses is confirmed by the way the student acquires knowledge as proposed in the above-mentioned Demonstration stage.

Thesis (1) is questioned by the fact that the students' "knowledge", i.e. the rule, does not come only from experience (Demonstration) which is its only confirmation because the rule itself de facto is not included in the experience. It can only be specified when we combine experience, "previous" knowledge and ability.

As we have already mentioned, the rule, in order to come into being, requires a heuristic element, a selection of data, interpretation, etc., plus observation. Therefore, thesis (2) cannot be applied to the Demonstration, either. Otherwise, through pure observation, the hypothesis/rule would never be achieved.

Thesis (3) cannot be confirmed since the Demonstration stimulates thinking — reasoning and inventing, expecting, predicting, etc. The a priori heuristic element plus inner capacity for learning a language (expectations) rather help than slow down the process of acquiring knowledge (cognition).

5. The Optimal Sequence of Grammatical Exercises (OSGE) was created to make up for a certain lack in most grammatical handbooks. It consisted in the fact that the amount of exercises that are mechanical in nature (skill forming) and only loosely connected with real and comprehensive understanding of grammar and the communicative aspect of the learnt material, totally outnumbered the amount of the exercises fulfilling the cognitive assumptions. Furthermore, most exercises corresponded only to two of the four basic phases of learning a foreign language: 1. presentation, 2. exercises, 3. communication, 4. testing; namely to 2. and 4. As a result, students in spite of a relatively satisfactory performance in "exercises" and "testing and reviewing", purely artificial activities, were unable to actually use the language in real communicative situations. In fact, these exercises did not manage to eliminate the frequent lack of transfer; audio-lingual pattern-practice drills being the most illustrative example. For these reasons, in most cases the exercises employed so far were a strikingly inefficient means of learning/teaching a foreign language, and a need for a modification of the old or creation of new types of exercises arose. The OSGE is an attempt to combine the two and proposes a certain selection and gradation/sequencing of grammatical exercises.

5.1 The OSGE consists of three basic units:

1. Competence exercise
2. Problem solving exercise
3. Contextualization exercise.

All the three stages correspond to stages of development of the student's knowledge of a given grammatical material — from mere recognition to usage. All exercises require conscious performance. However, the types of exercises

may vary depending on the rule the sequence is teaching. Let us now review types of exercises that can be used in consecutive units and the activities students are supposed to perform.

5.2 The competence unit is a direct continuation of the stage of presentation as propsed by W. Marton. Students have already been exposed to the data that was to enable them to find out the meaning of a given rule. Also in most cases the rule is already formulated. The competence exercise aims at giving students the first information about the correctness of their interpretation of the rule and of the recognition of the forms the rule utilizes.

The competence unit can consist, for instance, of the "account for" type of exercise, the multiple choice and translation (target lg into native lg) exercises. In these exercises student's behavior is carefully controlled either by the teacher's comments and corrections — when the exercise is done in class orally — or by the information included in the key — when students are supposed to respond in writing.

To sum up, the competence unit aims at checking the student's understanding of a given grammatical problem without involving his productive abilities. He is not supposed to use the rule in question by, for instance, making his own sentences. At this stage it is only necessary to realize the concept, remember the rule and the means of its manifestation. Although the task may seem to be very easy, a failure in the competence exercise can make it almost impossible for students to proceed with further stages of the OSGE. Students' behavior in the present unit is not productive. All they have to do is to recognize the rule/structure and its meaning correctly and practical application of the taught material is not required. The competence unit belongs to skill-getting phase as understood by W. Rivers (1972).

5.3 The problem solving unit by definition usually consists of a testing exercise. Here students make choices whether this or other rule should be used in a given context. The task is more complex than in the previous unit because they have to make decisions and actually produce the statements that include the grammatical rule in question. In order to do it correctly, a number of operations must be performed by students.

The types of exercises that might be included in this unit are the multiple choice exercise, translations from the native into target language, changing forms of particular elements in presented sentences, etc. The production in this unit makes the rule/structure in question seem less abstract or theoretical to students than before. They can now practically use the material they learn although it is still not a natural language use. Since no idea is put across, no communication takes place.

It seems that the problem solving unit contains elements from both the

skill-getting and the skill-using stages (Rivers 1972) in language learning. It is the practical knowledge of a part of the target language grammar that makes it possible for students to do the exercise correctly. Moreover, they consciously apply a given rule to make meaningful statements, producing meaningful utterances at the same time. By doing the problem solving exercises students learn the rule's value and practise its use.

5.4 The aim of the contextualization unit is to apply some communicative value to the grammatical rule or structure that is being taught. It is assumed that the lack of such exercises might be the reason why it is so difficult for students to use their knowledge in natural communicative situations. Therefore, the contextualization unit usually consists of an exercise which presents the context in which a given rule is very likely to be used in real situations.

The following type of exercise can constitute the present unit:

> John Brown is English. He is fifteen and lives in London. He has two sisters and a dog. His parents are doctors. Music and stamp-collecting are his main hobbies. Name at least three things you think John does every day (Marton, Lectures at Adam Mickiewicz University, 1977).

Students are here provided with real life context/situation and their responses must be logically connected with it. First they have to decode the message, i.e. understand the meaning. Then, provided they did it correctly, they have to associate the context with some grammatical rule/structure whose use can be considered correct in a given situation. Then some new idea, which is not included in the message, must arise in the students' minds. Finally, the message, which is encoded with the help of appropriate rule/structure, is very probable to occur as a response.

The whole process involves several operations that have to be performed — recognition and application of some grammatical phenomenon are accompanied by a creative element. Recognition consists of the perception of some grammatical forms, the discovering of the meaning, and the conscious choice of a proper means to give a correct response. At this point students have to realize that it is not enough to know the rule and how to use it but also when to use it; they start to realize that the language they are learning serves its natural purpose — communication. Although natural communication does not take place in either of the units of the OSGE, the last unit brings the abstract aspects of language (i.e. rules) closer to reality and teaches when one can make use of the acquired knowledge. It seems that providing students with a number of contexts is very helpful because then the practical aspect of language learning is usually maximized.

The contextualization unit of the OSGE is the least controlled one, for only in class can teachers correct the student's answers because, in most cases,

the amount of possible correct answers can be fairly large. It basically consists of making various choices and is thus far more complex than the competence and problem solving units because students also have to express their own ideas. It is the last step before students' future encounters with real interlocutors in natural communicative situations. Using W. Rivers' term, the contextualization unit can be regarded as skill-using (Rivers 1972).

It is not assumed that habit-like fluency in speaking the target language correctly is the outcome of doing the OSGE by students — it is only abundant communicative practice that can result in the internalization of the target language grammatical rules.

5.5 As we can see, the OSGE is characterized by a specific internal structure according to which its particular units are arranged. Since we have already classified the presentation as a construct based on the principles of hypotheticism, now we will try to prove that this is also the case with the OSGE. If this attempt turns out to be a success, the statement that exercises and presentation are mutually dependent will be confirmed.

The OSGE consists of three parts which constitute a hierarchical order if one proceeds from Unit One to Unit Three. Although in classroom practice it is possible to skip a particular part of the sequence or modify exercises in some other way, it seems reasonable to discuss the whole block preserving the original order of all units. Then the OSGE is characterized by the unity of method which structures both the presentation and the exercises themselves. Thus taking out one of their constituents, if we assume that the OSGE and presentation are the only parts of learning, would seriously slow down or impede the acquisition of the new material. Therefore, the OSGE closely resembles scientific testing whose particular stages follow one another, and the process of inquiry by no means resembles a set of random experiments.

5.6 The competence unit functions in the whole process of inquiry as the initial stage of experimentation. From the already formulated hypothesis conclusions are drawn and they are tested against experience. The student's first test — competence exercises — is characterized by minimal productive activation and relatively low complexity of the task. It stems from the fact that this stage aims at testing the most general aspects of the hypothesis in question, and the series of exercises itself tests either the formal and/or implicational aspects of the hypothesis. The task does not require a detailed analysis of the rule in order to draw further (indirect) conclusions from it, which in case of a grammatical rule pertain rather to usage than to understanding the significance, i.e. the main idea. Therefore, it seems that the competence unit in the

learning/teaching process functions as testing the concept (direct conclusions) and corresponds to the preliminary testing/experiments in scientific inquiry.

Further similarities can be noticed in the consequences of positive or negative results of the preliminary tests. Like in science, if the hypothesis proves to be correct, i.e. the attempts to falsify it failed, then it is temporarily considered as corroborated (Popper 1977) and thus worth further testing. On the other hand, if the hypothesis in question turns out to be false, e.g. the student uses a wrong justification or he is unable to give any justification at all of the forms, structures, tenses, etc. used in the "account for" type of exercises, then further testing is blocked until he rewords or reinterprets his hypothetical law. In such a case, also a definite rejection of the falsified hypothesis, which is replaced then by a new one, may take place. In the case of corroboration the student continues testing, i.e. he goes on to the next unit of the OSGE.

5.7 The problem solving unit corresponds to that phase of scientific justification which pertains to the experiments that take place after the preliminary testing. The hypothesis is now analyzed from the point of view of further implications that can be drawn from it. Now those implications are considered which are not directly deducible from the most general form of the starting hypothesis. The conclusions lead to a number of predictions according to which the student solves grammatical problems in the exercises belonging to this part of the OSGE. The starting hypothesis in question is tested in various contexts and the actual procedure of the student's testing takes many different forms depending on the type of exercise.

To sum up, the whole process consists in deducing hypothetical predictions from the hypothetical rule and testing them against practice. If the tests are successful, further testing takes place where other predictions are tested. Roughly speaking, it may look in the following way: the student is expected to change the form of the verb in the sentence:

John (drive) to church every Sunday.

Here the student has to draw a conclusion (prediction) from the very general law of the Simple Present Tense which includes forms, usage, special cases, etc. The conclusion which specifies usage says that the Simple Present Tense should be used when the subject's activity is characterized by time regularity, i.e. it is customary. The student tests it by putting the *-s* ending to the verb and then checks whether his hypothesis is correct. If so, he proceeds with further testing of various other predictions. In the case of negative tests he either modifies the starting hypothesis or rejects it and replaces it by another one.

In the case of a certain number of positive tests, the experiments are stopped and the student goes on to the third unit of the OSGE. At this point we may say that the starting hypothesis is corroborated, i.e. it has not been falsified by experience.

5.8 The contextualization unit constitutes that part of the scientific process where a given hypothesis, which has been confirmed by numerous experiments, becomes a law of science and is included into science. The given law functions now as a frame of reference for the future theories, enriches the already existing scientific knowledge and also has a practical function: it is applied to practice where it is used as a means for solving problems, explaining phenomena, etc. and/or as a technological instrument. And, similarly, the student has already tested the rule in question in many exercises and is now able to use it functionally. Therefore, the rule is added to his system of knowledge of the target language and can now be used in various natural situations, in various actual contexts. It will now serve its natural purpose, i.e. it will be used creatively for communication.

In fact, this very stage of including and further practical usage of a new element of one's system of knowledge is extended in language learning far beyond the range of the set of exercises discussed here. Further usage of the newly learnt element — the law — consists in constant testing, i.e. in applying it to more and more new situations. A complete interpretational and functional command of a grammatical rule in the target language in a native-like manner is very seldom reached. It is often the case with learning a foreign language grammar that people who study it most often possess only an approximation of the native-like grammatical proficiency and the "ideal" is hardly ever achieved. This phenomenon seems to correspond to the claim that irrespective of numerous experiments by which hypotheses are confirmed (not falsified) the hypotheses themselves are included into science as scientific laws only tentatively, i.e. until they are replaced by better ones (Popper 1977).

In conclusion, the three consecutive units of the OSGE impose on students certain procedures which, divided accordingly, correspond to the three stages of the context of justification. Namely, the competence unit, the problem solving unit, the contextualization unit resemble hypothetico-deductive preliminary testing, testing, and accepting hypotheses into science as laws of science, respectively.

The OSGE thus seems to correspond to the hypothetico-deductive method of scientific inquiry (justification). Both the presentation and the exercises constitute a very consistenthy pothetico-deductive sequence of scientific cog-

nition. Let us illustrate it in diagram 2:

Diagram 2

	PROPOSED METHOD	SCIENTIFIC PROCEDURE	
PRESENTATION	1. Advance Organizers (preparing insight) 2. Demonstration (h — t) 3. Orientation Practice (h — t) 4. Elicitation of Rule (h — t) 5. Formulation of Rule (h — t) 6. Mediator/Algorithm (h — t/a)	Formulation of Hypothesis	CONTEXT OF DISCOVERY
O S G E	Competence Unit	First Tests	CONTEXT OF JUSTIFICATION
	Problem Solving Unit	Experiments	
	Contextualization Unit	Inclusion into Science	

where "h — t" means that the activity can be performed according to the hypothesis-testing pattern, and "a" stands for application or inclusion into science.

Let us point out that both stages — the presentation (context of discovery) and the OSGE (context of justification) are here equally important and interdependent. The presentation as presented above has been given much consideration by its author, who elaborated it in great detail. It is probably intended to play an important role in the whole process of learning. As such emphasis is put on the type of presentation, the whole conception corresponds to those views which ascribe to the heuristic element in the context of discovery a very crucial role in the development of science (Such 1975:15).

6. The similarities between the behavioral concept of language learning and the inductive view on the process of scientific inquiry on the one hand, and between the cognitive view on language learning and the hypothetico-deductive concept of scientific process on the other, stem from the fact that the former

originated from empiricism and the latter from rationalism. The two methodological concepts are of a very general nature and the two psychological ones constitute their particular manifestations. Behavioral and cognitive psychology with the two trends in linguistics, structural and transformational-generative, contributed in large part to the creation of the two distinct approaches to language learning: the audio-lingual and cognitive, respectively.

It seems that the audio-lingual and the cognitive approaches can be derived not only from their psychological or linguistic backgrounds but also can be identified through the methodological analysis of the assumed procedures of the learning/teaching process. The two approaches, and thus methods and techniques, are based on appropriate principles of scientific inquiry. And so, the principles underlying the audio-lingual and cognitive approaches are inductive and hypothetico-deductive, respectively.

It follows from the above that one could use the criticism of the inductive procedures in science for criticizing the audio-lingual approach as a false one and vice versa. As we are not going to discuss this problem, let us only present the correspondences in question in the following way:

Diagram 3

CONCEPT	STAGES OF ACQUIRING KNOWLEDGE				
audio-lingual:	structure	→	generalization (aim: skill)	→	repetition
inductive:	facts	→	induction (aim: truth)	→	confirmation
hypothetico-deductive:	hypothesis	→	deduction (aim: truth)	→	falsification
cognitive:	law	→	analysis (aim: skill)	→	testing

The items in the above diagram do not pretend to denote exhaustively all the procedures and processes but symbolize only the characteristic features and phenomena at particular stages of cognition.

Let us note that both the methodology of science and language pedagogy makes a clear distinction between the context of discovery and justification, and between the presentation and exercises, respectively:

learning process	presentation	exercises
scientific process	context of discovery	context of justification

Presentation and exercises constitute the basic stages in the process of learning; the former pertains to the first contact with the problem/phenomenon which

is to be learnt/observed and the latter to further processing and/or use of new information. T. Krzeszowski (1976) calls exercises "fixing" but "fixing" itself has audio-lingual connotations and in the present paper "exercises" stand for a more universal notion which, for example, also includes usage.

It seems necessary to state the limitations of the scientific methods and their methodological analyses in language learning. In earlier chapters of this paper we have classified language learning as a particular type of acquiring systematic (scientific) knowledge. However, later on, as comparisons between scientists' and students' procedures were made, we were primarily concerned with the grammatical aspect of language. It seems reasonable to claim that the scientific methods in question should be restricted to grammar as the subject matter of students' "scientific inquiries". There are two reasons for this: first, of all elements of language, its grammatical aspects most closely resemble science, since both grammar and science are systems of laws. Second, scientific procedures seem to be most efficient in studying and mastering grammar since learning, for instance, pronunciation, vocabulary or collocations, put (if possible) into rules, would probably turn out to be a tedious and haphazard study rather than a systematic research.

6.1 As has been shown above, the OSGE and the presentation are constructed according to the principles of the hypothetico-deductive method of scientific inquiry. Therefore, it seems that the concepts underlying the proposed learning procedure consist in the assumption that human strategies in solving problems (learning a lagnguage) are scientific (hypothetico-deductive) in nature and pertain not only to discovery proper, but also to testing. Learning by discovery is here interpreted in a broader sense, i.e. not only as a process of acquiring knowledge (generating hypotheses) but also its subsequent usage (exercises and communication), both stages being subordinated to hypothetico-deductive principles.

Let us point out that language acquisition as described by J. Kess (1976) is a very consistent hypothetico-deductive process in which the child resembles a perfect scientist. It seems that the presentation and the OSGE are based on the assumption that the scientific method, which is hypothetico-deductive in essence, is preserved in adults.

6.2 It is noteworthy that in the proposed teaching sequence students in fact test whether their hypothetical grammatical rules fulfil the three requirements for the growth of knowledge:

1. "The new theory should proceed from some *simple*, *new* and *powerful*, *unifying idea* about some connection or relation (...) between hitherto unconnected things (...) or facts (...)".

2. (it) "should be *independently testable* (...); it must have new and testable consequences (...); it must lead to prediction of phenomena which have not so far been observed".
3. "the theory should pass some new, and severe tests" although "(...) even a theory which fails to meet it (this requirement — A. R.) can make an important contribution to science" (Popper 1965:241, 243).

The first requirement is fulfilled as the hypothesis in the presentation is made. The second is met in the problem solving unit and contextualization as they provide new situations (consequences) in which the law has not yet been tested. The third requirement is fulfilled especially in the second and third unit ("severe tests") where not only passing the tests but also refutations of hypotheses teach the student a lot and contribute to his knowledge significantly.

Therefore, one may claim that the concept of teaching grammar discussed above has a unique scientific rationale: if the student follows the hypothetico-deductive path in his study of grammar and his theories meet the three requirements, then he will succeed in developing his knowledge.

REFERENCES

Chastain, K. 1971. *The development of modern language skills. Theory to practice.* Philadelphia: The Center for Curriculum Development.

Giedymin, J. 1966. "Indukcjonizm i antyindukcjonizm". In Pawłowski, T. (ed.). 1966. 267–294.

Kess, J. F. 1976. *Psycholinguistics. Introductory perspective.* New York: Academic Press.

Krzeszowski, T. P. 1976. *Teaching English to Polish learners.* Warszawa: PWN (2nd edition).

Marton, W. 1976. *Nowe horyzonty nauczania języków obcych.* Warszawa: Wydawnictwa Szkolne i Pedagogiczne (2nd edition).

Pawłowski, T. (ed.). 1966. *Logiczna teoria nauki.* Warszawa: PWN.

Popper, K. R. 1965. *Conjectures and refutations.* London: Routledge and Kegan Paul.

Popper, K. R. 1977. *Logika odkrycia naukowego.* Warszawa: PWN.

Rivers, W. 1968. *Teaching foreign language skills.* Chicago: The University of Chicago Press.

Rivers, W. 1972. *Speaking in many tongues.* Rowley, Mass.: Newbury House.

Such, J. 1969. *Wstęp do metodologii ogólnej nauk.* Poznań: UAM.

Such, J. 1975. *Problemy weryfikacji wiedzy.* Warszawa: PWN.