

## CHAPTER 3

### THE PLACE AND MEANING OF REDUCING THE LEARNING MATERIAL IN THE LESSON STRUCTURE

#### 3.1 INTRODUCTION

If a teacher wants to acquire more purposefulness, be more scientific, and more certain in his/her teaching, and not act fortuitously, he/she must be able to give didactically accountable justifications for the construction of each phase of his/her lesson structure, without falling into a fixed pattern, or following recipes. From this, because of his/her greater knowledge and better skills, it is only a thoroughly prepared teacher who can give a justification for *what* he/she is going to do, *why*, and *how*. The didactic categories give certainty to the *what*, the lesson, and learning aim, to the *why*, as well as to the basic forms and methods which he/she (a teacher) uses to attain the aim, and the *how*. Corresponding to the teaching aim striven for in the didactic design, teaching and learning modes, which direct and bring into motion the activities of the pupils must be provided for. A clear delimitation of the lesson aim (teaching aim) is the first step which must precede designing an accountable lesson structure, and only then can a teacher anticipate the course of the lesson.

To construct a lesson structure, there are especially two aspects requiring thorough investigation, and interpretation, i.e., the teaching aim (lesson and learning aim), and the phases of the lesson. Below, the place and meaning of *reducing the learning material* to the teaching aim and then to indicate its place and meaning in each phase of the course of the lesson are connected.

The matters of reducing the learning material, and the lesson structure are differentiated into two primary moments, and each is fully explicated. On the one hand, this involves *preparation* by a teacher delimiting the lesson aim, out of the learning aim, as taken up in the syllabus, and, on the other hand, the *anticipated* course of

the lesson and the place and meaning of the reduction of learning material in each phase of the lesson.

## 3.2 THE TEACHING AIM AND REDUCING THE LEARNING MATERIAL

### 3.2.1 General

In school practice, as well as in some teacher training institutions, there is a separation between a direct and an indirect aim, or between a teaching and an educative aim. On the one hand, the teaching aim entails instilling knowledge, skills, and proficiencies in children and, on the other hand, the educative aim involves a teacher guiding, intervening, and assisting a child in terms of *norms* and values. The *teaching aim* is primarily concerned with contents, and the *educative aim* with the moral aspect. Such a separation, instead of a distinction, necessarily has a one-sided influence on the interaction and harmony between the teaching aim, as an objective moment, and the educative aim, as a subjective moment.

Along with the actualization of each teaching aim, there is an eye to bringing about change in a child. This change not only implies a knowing or intellectual change, but a change in disposition, i.e., change in a child as a totality.

### 3.2.2 The teaching aim and the “what” of teaching

To realize a teaching aim, a teacher must design a situation in which he/she is going to unlock *something* (content) for a child. Proceeding from the prescribed contents, a teacher searches further for a lesson form, by which he/she intends to attain optimal formative value. Although form is the constant factor in the original everyday lifeworld, this is different in planning. The content, as prescribed in the syllabus, is set, as is the class for whom it must be offered. Therefore, in planning a lesson, there must be a search for a lesson form and method which maximally unlock the prescribed content. Unlocking reality is only done justice when there is a double unlocking. This double unlocking means, on the one hand, that reality is unlocked for a child and, on the other hand, that a

child and his/her potentialities and, indirectly, him/herself, are thrown open for reality.

Regarding this, Van der Stoep<sup>28</sup> says: “Forming takes shape in the life of a child because he throws himself open for reality (subjective moment) but also because reality is thrown open for him (material or objective moment).”

In other words, if reality is unlocked for a child, he/she must respond to the appeal directed to him/her by both the form and the contents. By answering this appeal, i.e., by acting, a child shows him/herself in surrounding reality. Thus, it is part of the lesson aim for a child to enter reality as far as he/she can. This entering reality is important, in the sense that a child is going to discover his/her own potentialities under the imperative of the situation. Because of the self-discovery of his/her potentialities, it is expected that he/she is going to change. Because this changing implies a total changing, the separation between the subjective and objective moments of the teaching aim no longer is accepted. From the appeal of the form, as well as content, a child is stimulated, and he/she wants to learn.

About this, Mommers<sup>29</sup> says: “Forming is categorical forming in the double sense that a person unlocks reality for himself, and by this, he opens himself for reality, and categorical insights, experience, and lived experiences come about.”

In the event of double unlocking, therefore, there can never be a separation between the educative aim and the teaching aim, because the sense of teaching is in educating, and educating is actualized in teaching.

To attain his/her lesson aim, a teacher must unlock something (content) for a child. At the same time, the essentials of the lesson contents now become the *learning aim* of a child. Only if a teacher delimits and refines for him/herself the teaching aim can he/she plan a situation in which he/she, in his/her *representation* of reality, unlocks the essences for a child.

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<sup>28</sup> Van der Stoep, F., *Didaktiese grondvorme*, p. 17c.

<sup>29</sup> Mommers, C., *De plaats en de betekenis van het exemplarische onderwijs in de didactiek*, p. 40a.

For the sake of greater clarity, the teaching aim is described in greater detail.

### 3.2.3 Important aspects of the teaching aim

Since here we are concerned with a basic aspect of the lesson structure, it is important to be clear about the specific concepts and their meaningful relationships. For the sake of greater clarity, *five* aspects are discussed.

- The syllabus theme (its formative quality) and reducing the learning material.
- The lesson aim and reducing the learning material.
- The learning aim and reducing the learning material.
- Formulating the problem and reducing the learning material.
- The choice of example(s) and reducing the learning material.

The place and meaning of these various aspects for practice are indicated.

#### a) *The syllabus theme (its formative quality) and reducing the learning material*

We find a unique situation in school practice, i.e., certain contents are taken up as givens in a syllabus. Consequently, a teacher is compelled to begin his/her planning from and around these themes. Reality, or, more closely viewed, *cultural contents* are already evaluated, and certain facets of them are taken up and organized by the syllabus compilers. Today, because of the tremendous expansion of knowledge and research, it is no longer possible to offer everything to a child; hence, syllabus compilers are forced to make choices from a variety of possibilities. Therefore, a teacher must accept that each theme taken up in the syllabus has formative quality. In other words, there already is a *first, or earlier reduction* by the syllabus compilers, from which their choice of the theme is justified. In this regard, Gartner<sup>30</sup> says, “one does not indiscriminately incorporate scientific results into the school curriculum.”

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<sup>30</sup> Gartner, F., *Planung und Gestaltung des Unterrichts*, p. 242a.

With the compilation of the syllabus, there already is a thinking through of the “what” of teaching, from which the essence or formative quality of a certain matter has become evident.

b) *Lesson aim and reducing the learning material*

From the reduction of the theme to its essence by a teacher, and his/her interpretation of the learning aim which has become visible, in his/her preparation, he/she now can give form to the lesson aim. The lesson aim embodies the form and *ways* on which his/her planning rests and gives an idea of how he/she intends to attain the learning aim.

The first task of a teacher, as someone who knows and commands his/her subject, is to interpret the learning aim. To do this, it is necessary that he/she reduce, for him/herself, the theme as taken up in the syllabus, to its essentials. His/her interpretation and representation, accordingly, must be *meaningful* for a child, and *be focused* on the learning aim, i.e., unlock the essence of the matter. He/she must plan his/her lesson aim (forms and ways of teaching) such that the formative quality of the matter is made optimally available.

These two reduction steps, thus, require the formulation of a lesson aim in which there is harmony between *what* is taught and *how*. From this, the reduction of the theme by a teacher, and his/her interpretation of the disclosed learning aim are of fundamental significance for any didactic design. Hence, it is necessary to pause here and indicate a few additional aspects.

It is indicated that the reduction by a teacher is directed to laying bare what is essential to the theme. This reduction gives a teacher greater certainty about the primary nature of the learning aim. Hence, reducing the learning content makes the learning aim visible, i.e., what a child must acquire for him/herself. However, for a teacher, this has additional implications. By formulating his/her teaching or lesson aim, he/she not only must reduce the theme to its essentials, but he/she must strive to present it in the proper context for a child, so that the unique nature and structure of the subject matter are disclosed. His/her lesson aim, then, must not

only encompass the factual aim, but also show the form, i.e., the structure, relations, organization, and good methods.

Any one-sided emphasis of the contents (language, symbols, and formulas of the subject) easily can lead to confusion, and to verbalisms (non-functional knowing).

From the above, it is evident the cardinal aspects of the learning aim cannot simply be read off the syllabus but must be delimited and refined once again by teacher. Then he/she must interpret the essentials of the matter and formulate his/her lesson aim accordingly. This brings us to the important aspect of stating a problem and, particularly, how the disclosures resulting from the reduction give rise to the meaningful statement of a problem.

c) *The learning aim, stating the problem and reducing the learning material*

Above it is indicated that the learning aim is already embedded in the *theme*, and that the theme is adopted in the curriculum because of its formative quality.

By a teacher's act of reduction, the learning aim is disclosed anew as the essence of the matter and is taken up in his/her lesson aim. However, where his/her lesson aim involves both the *what* and the *how* of the teaching event, it now becomes important to look at the path which must be followed to transform the *learning aim* into a problem for a child.

It makes no sense for a teacher to enter his/her classroom and simply announce the problem, because in doing so, there is *no problem for a child*. Thus, at the beginning of a lesson, it is no use to announce the *theme* as the learning aim. Before the situation can direct any appeal to a child, its form as well as contents must have sense and meaning for a child. Only when a child him/herself gives meaning to the matter can he/she discover the incompleteness of his/her equipment, i.e., become aware of aspects which are strange and unclear and, thus, are problematic for him/her. The learning aim can only be shaped into a problem for a child if, because of his/her ready knowledge and understanding, he/she can give meaning to it.

To make a problem meaningful for a child, the learning aim must be changed into a question for him/her. Such a questioning attitude can only be actualized if a child can be stimulated to self-activity because he/she is sensing something unknown, strange, surprising, or even amusing. As soon as he/she confronts the matter, he/she begins to search for “something” known which he/she can isolate and name. Thus, he/she can only *give meaning* if a part-aspect appears which he/she recognizes from his/her foreknowledge. Hence, because of his/her awareness of the learning aim, it is a teacher’s task to anticipate what foreknowledge must be actualized so it can be a starting point for stating a problem. (The actualization of foreknowledge is considered later in the chapter with respect to the course of the lesson).

Van der Stoep<sup>31</sup> also refers to the importance of a meaningful linking up with a child’s foreknowledge when he/she explains that “today it is generally accepted that the phenomenon of learning has its beginning in a meaningful problem”. Thus, when a child gives meaning to a theme, orders, and systematizes it, only then can he/she disclose to him/herself the incompleteness of his/her own knowing. The significance of actualizing foreknowledge in an early stage of a lesson is that knowledge, proficiencies and skills are made explicit, and are the basis on which the first attribution of meaning by a child begins. Because this foreknowledge already embraces *part aspects* of the final gestalt, this event already can be viewed as an *accompanied reduction*. In actualizing foreknowledge, certain concepts are thrust to the foreground., and then constitute part of the learning aim, but a child also becomes aware of the *incompleteness* of his/her knowledge about the matter.

The disquiet, surprise, and uncertainty which, in this way, are awakened in a child, force him/her to distance him/herself from his/her *foreknowledge* and, once again, to cast doubt on what he/she already knows. Now, a child approaches the matter more objectively through more accurate perceiving. This is seen in an act of exploring and is typified as a form of *self-reduction*. Through his/her further analysis and attribution of meaning, a child

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<sup>31</sup> Van der Stoep, F., *Didaktiese grondvorme*, p. 41c.

succeeds in delimiting a certain aspect as problematic, or another as one of possible meaning.

For didactics, this distinction between accompanied- and self-reduction points to two important concepts which have great relevance in planning the modes of learning, and the choice of teaching aids. When a teacher succeeds in meaningfully linking the foreknowledge and learning aim and, thus, gives direction to a child's learning activities, a child also more easily will arrive at an awareness of a problem and, in doing so, will more quickly and directly begin to ask questions. These questions from a child are his/her first attempt to formulate his/her own problem which has become visible from the disclosures shown by his/her own acts of reduction.

d) *Formulating the problem and reducing the learning material*

From the various questions the learners now asks from their refined and directed perceiving, a teacher now can summarize the learning problem, and formulate it in the language of the pupils. However, it still is a task for a teacher to complete and broaden the insights and perceptions of the children, which still fall short of the mark. From the pupils' questions, based on their self-reductions, they can be led in a class discussion to formulate the problem. The problem, by which the essence of the theme is made clearly visible to a child as a learning aim, also must be summarized for him/her (a child) in understandable and familiar language. Regarding this, Roth<sup>32</sup> adds: "In language suitable to the child's age."

When the pupil has arrived at his/her own formulation of the problem (learning aim), there can be a search for possible solutions. The general procedure is for a teacher to show one or another good example, and then deal with it together with a child, and then give a child an opportunity to deal with it him/herself. At this stage of planning the lesson structure, the choice of a good example is real and deserves further attention.

e) *The choice of example and reducing the learning content*

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<sup>32</sup> Roth, H., *Leerpsychologie in pedagogisch perspektief*, p. 77a.



To unlock the learning aim for a child, a teacher must select one or more examples by which the essence of the theme is made visible. Thus, it is necessary to search for examples which inherently contain and mirror for a child the essence(s) of the learning aim. To acquire greater assurance regarding the quality of an example, and if it can be effectively used to expose the new, the example itself must first be *reduced*. Once a teacher selects an example, in terms of his/her reduced information, he/she must consider whether such an example can be sufficient for unlocking, and if there must be a search for a supplementary example. Therefore, it is only possible, based on a child's insight regarding the first example, for a teacher to plan further and determine to what extent provision must be made for additional examples. By choosing additional examples, and by determining their formative quality, a teacher can plan his/her learning aim with greater certainty. The reduction of learning material must never be equated with a mere analysis or simplification because, although there is a search for the simple example, it must always be recognizable as a meaningful exemplar of a subject matter. Since, for each subject matter, there are certain examples which lend themselves better to designing a fruitful learning situation, it is necessary to go into this more deeply.

*The example and the unique nature of the subject matter:* In evaluating an example, the nature of the subject must not be lost sight of. The field of study, its language, validity, and typical methods are aspects which can influence the choice of an example. Thus, in most subjects, there are examples which are extremely suitable for embodying a facet or aspect of the reality [of concern]. Here, one thinks of classical, traditional, and model cases, where specific examples are used repeatedly by various persons to clarify a matter for others. The logical, exact, and abstract character of mathematics makes it especially susceptible to the use of such fixed or even stereotypic examples in unlocking a concept.

*The example and the method:* The choice of a good example by a teacher is not only influenced by its intrinsic value for disclosing the essence of a concept and, especially its linguistic meaning, but sometimes it is chosen primarily because it effectively shows an approach, or good method of solution. Here, one thinks of the great variety of examples which generally are given in a classroom for

practicing the usual methods for analyzing factors. This mainly concerns the choice of examples by which a methodological *aspect* of a subject can be practiced. In addition to choosing an example because of its significance for unlocking the *what*, sometimes it is chosen to unlock the *how*.

*The example and meaningful relationships:* In addition to choosing an example for its quality to clarify concepts, or where it is applied and constructed to disclose a methodological aspect, the solution sometimes only breaks through in disclosing a new relationship. Herein lies the meaning of reproductive and productive tasks in each subject. The example now chosen must make possible a new structure (productive) or a restructuring (reproductive) of an earlier insight. In both of these thought-structures, the example allows the *insight* to break through with respect to a new relationship or series of relationships by which a child is lead to the solution of a stated [lesson] problem.

According to Van Hiele, the course of matters in the origin of insight in geometry is described in the following four points:

First. a structuring occurs in the field of perceiving.

This structuring is paired with various words.

The structuring of the observable is increasingly taken over by the linguistic structuring.

A certain autonomy of the linguistic structuring arises.

In other words, the realization of insight involves a perceptual structuring, a linguistic structuring, and a logical structuring which partially work together and complement each other, but which, in the long run, the latter supplants the former.

*The example and the readiness of a child:* Because the example (content) is always chosen for a certain subject matter and class, it is equally important to take into consideration the readiness of a child to not overlook the unique nature and structure of the subject matter [and a child]. Before there can be an appeal stemming from the content (example), it must be made sure that it is possible for a child to give sense and meaning to what he/she is confronting.

Therefore, on the one hand, examples which are too difficult or foreign to life for a child must be avoided. On the other hand, examples which are too simple or concrete cannot show the quality in terms of which fruitful learning situations can be brought about. By choosing a too simple example, a teacher loses an opportunity to confront a child with a meaningful problem which challenges his/her achieving consciousness and, thus, stimulates him/her. Too many realistic or concrete examples can only confuse and, thus, block clear concept formation.

Above, an image is given of the teaching aim and how it figures in the reduction of the learning material in each phase of a teacher's preparation and delimitation of his/her lesson aim. The significance of all this work of a teacher regarding the didactic design is, however, that it makes his/her practice possible. Therefore, it is meaningful to attend to the course of the lesson and to show, along with the aim, the place and meaning of the reduction of the learning material in it.

### **3.3 THE COURSE OF THE LESSON AND REDUCING THE LEARNING MATERIAL**

Each course or phase of a lesson is a unique event which can never be repeated. The part-concept "course" refers to the lesson spanning time with certain activities characterizing its beginning; other activities continually repeating themselves as far as form is concerned during the progression of the lesson, and then there also are matters which are distinguishable at its end. For a more differentiated discussion of the course of a lesson, the following *six* phases are distinguished where each has a relationship to the matter of reducing the learning material. First, a synoptic scheme is given of the course or sequence structure as this is generally actualized with some modifications, and stronger emphases of one or another aspect in each lesson situation.

#### *Course of the lesson*

Actualizing foreknowledge.

Stating and formulating the problem.

Exposing the new.

Actualizing the learning content.  
Functionalizing the new insights.  
Evaluating.

Now, the significance of reducing the learning material for each of these phases is shown.

### 3.3.1 Actualizing foreknowledge

To clearly grasp what precisely is planned during this phase, certain concepts are elucidated.

#### a) *What is actualizing?*

*Actualizing* is derived from the adjective *actual*, which means real, essential, existing, actual, present, or immediate, and is adopted from the Middle English word, *actuel*. *Actuel*, further, is traced back to the Latin *actualis*, and *actus*, which mean to do, or to act.

In everyday life, actualizing has a wide variety of meanings, such as making actual, realizing, and to materialize.

#### b) *What is foreknowledge?*

In planning a lesson structure, a teacher assumes the pupils already have a minimum amount of knowledge, proficiencies, and skills available which can be made explicit. Thus, actualizing foreknowledge means that only the relevant foreknowledge, i.e., what is viewed as necessary for giving meaning and solving the new theme [problem], is recalled. Only the foreknowledge which, from a teacher's reduction of the theme, he/she views as a meaningful starting point and basic [possessed] insight, is brought to the fore again. Such fundamental concepts, insights into relationships, and methods, which now are on hand each moment, make a child susceptible and sensitive to the exposition of the new. A teacher cannot assume that themes previously dealt with, and which are relevant to the present situation, are merely going to function spontaneously, and as explicit knowledge. Thus, a teacher's first task is to help a child be secure and mobile regarding such beacons, and focal points from which all future structures acquire their

beginning. Therefore, to bring about the possibility for a meaningful unlocking, a teacher must anticipate a field of foreknowledge. By actualizing this relevant foreknowledge, a foundation is prepared for a fruitful and meaningful linking up to and exposition of the new theme(s). Actualizing foreknowledge is an important aspect of a teacher's preparation, and this requires an explication.

c) *Actualizing foreknowledge and the preparation by a teacher*

The content theme or learning aim is given in the syllabus for a teacher. However, to delimit and refine the learning aim to its essence, a teacher must reduce it, and strip it of all [irrelevant] details. But this is only part of a teacher's preparation. Before the new theme, as learning aim, can acquire any sense and meaning for a child, a teacher must take care that certain basic concepts and methods of solution, which are viewed as linking up points and beacons for further orientation, first are made explicit. The preparation by a teacher, as is observable in his/her lesson aim, requires thorough planning of the content, as well as the form moments regarding actualizing foreknowledge. As far as his/her preparation is concerned regarding the contents, on the one hand, there must be a search for a linking up with the original and near to reality experiences of a child. On the other hand, specific attention must be given to the *lesson form*, in accordance with the level of readiness of a child and the nature of the subject matter.

d) *Actualizing foreknowledge and the choice of a lesson form*

As part of his/her preparation, it is expected that a teacher reflects on the question of *lesson form* and how he/she wants to bring the content to the fore again. In other words, this has to do with the choice of the most effective ground-form(s) he/she is going to use to actualize the foreknowledge. However, to bring *movement* into an otherwise rigid lesson form, a teacher cannot omit thinking about one or more principles of actualization, and how they can help a child to actually be actively involved in the learning event.

e) *Actualizing foreknowledge and the choice of certain didactic principles*

To provide greater security to a learning event and, especially with the aim of a child's effective and active involvement in the event, in his/her preparation and planning, a teacher finally must decide what principle(s) of actualization, mode(s) of learning, teaching- and learning-aids he/she is going to use in the lesson.

From the above, it is evident that a teacher's planning of each phase of the lesson structure, in general, as noted here with his/her reflections on actualizing foreknowledge, shows a clear interaction and dependence between the choice of the form, the content component, and the lesson aim. Indirectly, therefore, this refers to what became visible as essence and constant, when a teacher reduced the learning material. Without him/her delimiting the essentials of the matter, he/she cannot succeed in anticipating and constructing a lesson structure which can lead to effective learning.

In the following phase, i.e., stating the problem, there is an attempt by a teacher to further stimulate a pupil, such that the learning aim becomes a problem for him/her. In his/her striving and search for a possible solution, a child then, him/herself, discloses the essences.

### **3.3.2 Stating and formulating the problem**

Stating the problem puts the pupils in a situation in which the actualized foreknowledge is brought up, and the sense and meaning of the matter is pointed out. At the same time, however, a child now becomes aware of the incompleteness of his/her knowledge about the matter. Becoming aware of "something" problematic forces a pupil back to the reality itself, where he/she now tries further to *analyze* and distinguish between things which appear to be *known* and *unknown*. Should problems now arise, he/she turns to an adult by asking questions. A child's entry into reality with the aim of testing his/her knowledge of the matter, and his/her questions to an adult, both are expressions of purposive acts of reduction. Through his/her own lived experiencing of what appears to be a problem, and the indications by the adults, a child gradually arrives at a formulation of the problem. That is, he/she succeeds in stating the problem in his/her own words. This then indicates to a teacher that

a fruitful moment has dawned for presenting a solution, or for providing help and support, which make the discovery possible.

### 3.3.3 Exposing the new

For the sake of clarity and lucidity, a closer conceptual analysis is given.

#### a) *What is exposition?*

The concept is derived from the Latin, *exposition*, which means showing, exhibiting. In its turn, *expositio* is derived from, *expositus*, the past participle of *exponere*, and means to expose, explain, clarify, or elucidate.

In everyday usage, exposition means to display, show, explain a logical concept by examples.

#### b) *Exposition and examples*

In didactic theory, regarding the ground-forms, using the example for unlocking new learning contents is a form of living which, as a general lesson form, is accepted in teaching. (The choice of a good example is broached in 3.2.3e). One or more examples are shown, by which a teacher makes the disclosure of the problem enjoyable for a child. Thus, the meaning of his/her exposition, or explanation of the chosen example(s) is that it serves as an effective representation of the essence of the matter. In *explicating* an example, a teacher intends to help a child to him/herself reduce the matter to its essence. Usually, an example is chosen for its simple and direct exposure of a solution to the problem, i.e., the essence of the matter, as summarized in the learning aim, and verbalized in the learning plan.

Here, the exposition of the new, either in the form of showing by a teacher, or in the form of acting jointly, where a teacher, along with the pupils, penetrate the example, is a moment in planning most lessons. Usually, a child is not left to his/her own devices to search for a solution, because this is often a fruitless use of time. By exposing a good example, an adult helps a child to effectively penetrate to the essence of the matter and, in doing so, a child arrives at greater certainty and self-confidence regarding this aspect

of reality. At the same time, the exposition helps show the pupils any specific or typical method(s) for solving the problem. The example a teacher chooses for delineating the essences of the learning aim, now is a model for a child by which he/she, on his/her own, can tackle new problems with greater confidence. Insight into the solution, as presented by a teacher, however, is no guarantee that a child can solve similar or relevant problems on his/her own. Therefore, the exposing goes further, and one or more examples is dealt with jointly with the pupils before they try to deal with the problem on their own.

The example selected to be acted on jointly with a child, also serves as a medium for checking. After the initial explication, it is necessary, as quickly as feasible, to check and determine the extent to which the pupils have acquired insight into the concept before any additional practice or rehearsal can have any value. Only after a teacher has made sure the pupils have acquired the basic insights, and when he/she has helped them make the fundamental knowledge and skills their own, can there be a move to integrating and functionalizing the new content. In other words, a teacher must verify if the essence of the matter, as revealed during his/her original reduction, now is interpreted by a child accordingly. Thus, in this phase, checking only means verifying that the essences or focal points, which must be on hand as beacons, are there before any additional constituting is possible.

Van Hiele<sup>33</sup> gives the following warning in this regard: “Also, when full joint participation is provided the pupils, there is a need for continual checking. For the present, the control aims at putting the pupils in the highest position to progress in the direction of the insight.” Continual verification is needed. This must occur in each phase of a lesson so that there is certainty about the mastery of each new essence. Van der Stoep<sup>34</sup> says: “Without checking and guidance, there is no accountability and responsibility, also no possibility of remedying a child’s problems, or correcting didactic errors (by a teacher).” Checking the essences in each phase of a lesson, therefore, is a necessary task for every teacher because there is the

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<sup>33</sup> Van Hiele, P. M., *De Problematiek van het inzicht*, p. 122a.

<sup>34</sup> Van der Stoep, F., *Didaktiese grondvorme*, p. 43c.



danger that the pupils remain unsure about the matter. Because the explication by a teacher seems to be so logical and obvious, this sometimes contributes to the pupils having the misconception that they understand the matter, but as soon as they are pertinently confronted with the matter, they first discover for themselves the real problems. From this, exposing the new must always be followed by activities which actualize the learning content.

A teacher's exposition, thus, embraces a phase of the lesson structure in which he/she shows "something", as well as where he/she works jointly with the pupils.

### **3.3.4 Actualizing the learning content**

The main aim of this phase is to verify if the pupils have come *to* insight.

#### *a) Reviewing the essences*

There is the danger that a teacher, but especially the pupils, can have the mistaken impression that insight into one or two examples is sufficient, and this can result in neglecting functionalizing the new knowledge. It is in this phase that a summary and synoptic scheme can be very helpful for a child to again orient him/herself to the matter in its totality and, thus, to see the essences in their mutual perspectives.

Thus, the new learning contents are summed up by a teacher and, where feasible, is illustrated. The reviewing, however, also can be directed to a child establishing greater skills and allowing him/her to acquire greater mobility in applying specific methods. Consequently, reviewing is closely related to practicing. If, during the rehearsing, it becomes clear that the class or individual pupils still have not mastered the essences of the matter with insight, a situation must be planned in which the pupils jointly work on examples, and even alone, and by which the fruitful moment for the breakthrough of insight is brought about.

#### *b) Practicing to insight*

In general, at this point, insight has broken through for most of the pupils and there can be a move to the additional *practicing of these insights* in terms of new and varied problems. However, it is

possible that, with some pupils, insight is still lacking, and an opportunity must be provided *for practicing, not so much of insight*, as the practicing *to* insight. By wrestling with a few varied application problems, a child learns to know the essences and interpret their meaning. An example(s) is now worked through jointly with the pupils, or the usual procedure is that a few carefully chosen and evaluated examples are given to the pupils to work through by themselves. It is important that a teacher first be certain that a child has acquired insight into the matter before there is additional work.

c) *Naming and schematizing*

One must guard against the danger of verbalisms because of too early a verbalization in the [technical] language of the subject area. Therefore, it is desirable that a child first try to give a possible solution in his/her own language before proceeding to an exact formulation with the help of other pupils or a teacher. However, before he/she can loosen him/herself from the specific example(s), and think about the matter on an abstract level and in a general sense, he/she must be led to delimit the essence of the matter and see it [him/herself] as a commonality. Therefore, a synoptic scheme and summarizing representation of the matter, at this phase of the lesson, can be of great help to a child seeing the general law, definition, or inference. The essences and relationships become clarified by schematizing, and this directly helps the pupils better orient themselves.

### 3.3.5 Functionalizing as a moment of the course of the lesson

For greater clarity, the concept functionalizing is first explicated.

a) *What is functionalizing?*

Functionalizing is a derivation of the word *function*, which means to work, working, performing a task, activity, or a ministering. Function, in its turn, is adopted from the Old French, *function*, and the Latin, *functio*. The past participle, *functus*, now means, more specifically, executing or performing.

The first functionalizing or learning activity in this phase is directed to the pupils' greater achievement and skillfulness. That is, through

directly practicing the new knowledge, it becomes one's own learned possession.

b) *Practicing of insight, as a moment of functionalizing*

There is a clear and important distinction between the concepts *practicing to* and *practicing of* insight. By presenting and working with examples jointly with the pupils, a teacher guides them *to* insight into the essences, meaningful relationships, and methods which refer to the learning aim. However, it is necessary that, as soon as the insight has broken through, one proceeds to practicing *of* insight. The aim here is to help the pupils break loose from the specific example(s) shown and worked on jointly. Incidentally, this also involves actualizing learning activities which elevate the skillfulness of a child in using new methods of solution and approaches and, consequently, make him/her more mobile in using and applying the newly acquired knowledge and laws.

Functionalizing eventually leads to committing the new knowledge to memory and becoming automatisms. However, before this new knowledge can be utilized fully, and before broad knowledge and *possibilities of transfer* can be acquired, it first must be meaningfully integrated with the foreknowledge.

c) *Integration as a further moment of functionalizing*

There must be an attempt to indicate the meaningful relationships existing between the newly acquired knowledge and germane ready knowledge. By integrating the new and the old, there is a progression to greater unity and general structures in terms of which the pupils, in subsequent applications can arrive at greater mobility and certainty. Van der Stoep<sup>35</sup> says the following about integration: "By integration, as a truism of learning, one must understand that the learning person already possesses a quantity of knowledge and that newly acquired knowledge must be assimilated and integrated into this already existing totality of knowledge. This matter has its cognitive and affective moments and, in these ways, touch all the activities of the achieving consciousness."

d) *Applications and functionalizing*

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<sup>35</sup> Van der Stoep, F., *Didaktiese grondvorme*, p. 81.

The acquired insights now are practiced with examples which the pupils themselves must work through. The sense and meaning of the applications are that a child now is confronted with new problems from related themes of the same subject, or from neighboring subjects, or even from reality outside school. Thus, it is expected that the pupil transfers his/her newly acquired insights and knowledge and applies them to matters (problems) which are detached from the examples by which he/she originally learned them. Only in using his/her mathematical knowledge in daily life and applying this in solving problems in other subject areas, such as physics and arithmetic, does a child really discover the benefits and meanings of his/her new acquisitions. It also helps if he/she does not construct two worlds—one in the school, and the other outside school. Consequently, the mathematical knowledge, proficiencies, and skills acquired in school have formative value. Only if there is a fruitfully applicable transfer and quickened tempo can a teacher accept that the insight is practiced.

Van Hiele<sup>36</sup> says: “Thus, we can say that insight is recognized, as such, if the examined intentionally acts adequately in new situations.”

### 3.3.6 Evaluating

The concept evaluating is first clarified.

#### a) *What is evaluating?*

The verb *evaluate* means to estimate, to assess, to appraise, to rate, or to value. The concept is derived from the Latin, *valere*, which means to be of strength, or health, or worth. In everyday life, it has acquired the meaning of estimating, appraising, and valuating.

#### b) *The aim of evaluating*

The aim of evaluating is to compare the *achievement* of the pupils, as well as give them an opportunity to disclose themselves. In addition to verifying the essences, there is an evaluation of the essences of the learning aim, the methods, skills, and applications in

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<sup>36</sup> Van Hiele, P. M., *De Problematiek van het inzicht*, p. 11b.

new situations. Thus, there must be an attempt to evaluate insight, as well as skills.

c) *The necessity of evaluation*

Evaluating the pupils is a necessity because, in doing so, a teacher checks *him/herself*. Evaluating not only helps a teacher form an image of his/her pupils' work, but of his/her own teaching. Problems of individual pupils, and problems with which the whole class co-experiences difficulties in a sub-unit, possibly can be indicated in a test.

About this, Alletson<sup>37</sup> says: "It is in the errors that the pupils' individual difficulties are manifested. A teacher ought to be as a doctor who by perceiving the symptoms of the sick can restore his patient to being healthy."

Thus, it is a teacher's task to analyze the errors the pupils make on tests, and to look for their possible origins.

### 3.7 SUMMARY

The place and meaning of reducing the learning material are mainly differentiated into two moments: the preparation by a teacher, where he/she delimits the lesson aim from the learning aim as taken up in the learning plan, and the anticipation of an accountable course of a lesson. Because today, it no longer is possible to offer everything to a child, it is accepted that each theme taken up in the learning plan possesses formative quality, i.e., there is a first, or earlier reduction by which the choice of the theme is justified. Consequently, the first task of a teacher is to reduce to its essences for him/herself the theme as taken up while learning, because he/she must plan his/her lesson aim so that the available formative quality of the matter is used optimally. These two reduction steps must lead to formulating a lesson aim, within which there is harmony between the *what* (content) and the *how* (form) of teaching.

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<sup>37</sup> Alletson, D. C., *Die onderwys van elementere Wiskunde*, p. 20b.

To make a problem meaningful for a child, the learning aim must be changed into a question [problem] for a child. This questioning attitude can only be realized if a child can be stimulated to self-activity, because he/she senses something as unknown. As soon as a child steps up to the matter, he/she searches for “something” which he/she can isolate and name, as known. Thus, he/she can only attribute meaning if part aspects come to light, which he/she recognizes from his/her foreknowledge. Therefore, it is a teacher’s task to anticipate, based on his/her awareness of the learning aim, what foreknowledge must be actualized. Actualizing foreknowledge is viewed as *guided reduction*. Then a child can become aware of the *incompleteness* of his/her existing knowledge about the matter. The uncertainty this awakens in a child forces him/her to question what he/she already knows, and this is typified as a form of *self-reduction* or *personal reduction*. Thus, a child succeeds in delimiting certain aspects as problematic for him/her, which then leads to direct questions, as the first attempt at formulating his/her own problem. Now, the general procedure is that a teacher, with one or another good example, shows the example, another is jointly dealt with, and then a child is given an opportunity to deal with many him/herself. Therefore, it is necessary to search for examples which inherently include the essences of the learning aim and can mirror them for a child. To acquire greater certainty regarding the quality of the example, and if it can be applied effectively in exposing the new, the example(s) also first must *be reduced*.

In choosing a good example, the nature of the subject, good methods of solution, meaningful relationships, and the readiness of a child must be considered. The meaning of all this work by a teacher regarding the didactic design is that it makes his/her practice possible.

In the first phase of the course of the lesson, foreknowledge is brought to the fore which, from his/her reduction of the theme, is viewed as meaningful points of linkage and basic insights. As part of his/her preparation, it is expected that a teacher reflects on the lesson form he/she is going to use to actualize the foreknowledge. However, to bring movement into an otherwise rigid lesson form, a teacher also must reflect on using one or more principle of actualization. If, in terms of the accompanied reduction

(actualization foreknowledge), a child is led, in his/her own self-reduction, to formulate a problem, the further course of the lesson will proceed as follows.

The example or examples chosen for exposing the new, now are presented by a teacher, then one or more examples are jointly dealt with, and then the pupils are given an opportunity to deal with a few good examples themselves.

To form an image of his/her pupils' work, and of his/her own teaching, a teacher must evaluate insight as well as skills.

In terms of the themes from the mathematics syllabus, the following chapter shows, on the one hand, how the theory of the previous chapters can be transferred to practice. On the other hand, the examples can serve as *guidelines* for mathematics teachers who, in the future, will plan lesson situations themselves.