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"FROM THE BACK OF THE CLASSROOM I UNDERSTAND MY STUDENTS MUCH BETTER!" SECONDARY SCHOOL TEACHERS EXPERIMENT WITH INCORPORATING ICT INTO THEIR TEACHING[1]

The SUMUME project "Enseignement avec SUpports MultiMEdias" (teaching with multi-media support) is the product of a collaboration between the canton of Neuchâtel (the Department of Public Instruction and Cultural Affairs), a business enterprise (BIP Info SA) and a university department (the Institute of Psychology of the University of Neuchâtel). It involved the production by practicing teachers of three sequences of teaching with multi-media support – in French, mathematics, and history-geography.
The involved teachers developed tools suited to their particular needs and the didactic of their subjects. It rapidly became apparent that the educational software had the effect of transforming their modes of teaching in interesting ways. In particular it created the opportunity to take on another role: they became conceivers of the instruments of learning, organisers, coaches and advisors, all the while remaining engaged in the transmission of knowledge but with the benefit of a more personalised supervision of their pupils. And they found their viewpoint changed: it was no longer by facing the class but from the back of it that they understood their students better!

*Key Words: t*eaching with multimedia supports; teacher-pupil relations; classroom interaction; interprofessional collaboration, teacher's role.

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Introduction

Our intention here is to present some of the lessons learned from a project in which we have been participants rather than to offer a contribution to the so-called 'fundamental' research. Although fundamental research is enriched by observations and analyses of practice, these latter can only acquire scientific value to the extent they are subjected to empirical verification and theoretical integration. This exchange between scientific research on one hand and practical application and technical development on the other, between practical experience in dealing with reality and reflection, between the desire to do things and curiosity-driven exploration, between the wish to understand and the aspiration to put things into practical effect, this exchange has truly the capacity to energise professional practice (Garduño, 1998; Perret-Clermont, 1980; Perret & Perret-Clermont, 2001; Action DORE). This vitality can only be born out of a documentation of experience to ensure that it is the object of evaluative reflection after the event.

The project we present here concerns a situation in which new media technologies were introduced into classrooms following the inputs of policy makers, engineers, researchers and authors, these last having been recruited among the teachers using these technologies.

We will first describe the nature of the experiment and secondly we will present examples of the teaching – plucked fresh from this rapidly developing area.

1. Presentation of the project

The idea for this project — which was to be christened SUMUME — was the brain-child of Martin Lehmann, the company director of BIP Info SA. Having convinced an industrialist friend to become involved, he contacted the Institute of Psychology at the University of Neuchâtel, with which he had already collaborated for several years. There were then meetings with a government minister, Thierry Béguin, head of the Canton's Department of Public Instruction and Cultural Affair, then which it was suggested that an experimental pilot project be established to examine teaching with multi-media support.

The SUMUME project, "Enseignement avec SUpports MUltiMEdias" (teaching with multimedia support), was thus a collaborative venture between the Department of Public Instruction and Cultural Affairs, a business enterprise — BIP Info SA — and the Institute of Psychology

at the University of Neuchâtel. The collaboration was undoubtedly facilitated by the scale and independence of the educational system of a small state (the Republic and Canton of Neuchâtel). All this made contacts between the different partners much easier. Such contacts would most certainly have been more difficult if not impossible in a more centralised, strongly hierarchical system in which any decision would involve a large number of interests and considerable geographical distances and in consequence a multiplicity of personal and institutional links. However, although this context undoubtedly facilitated the initiative, tit should not been assumed that this experience cannot be adopted by larger systems. Rather, the enlargement of such an approach, bringing together policy makers and practitioners, engineers and researchers, would require the explicit elaboration of a system of management of the innovation/diversification/diffusion relationship. The procedures developed by Ivic and colleagues (2001) provide a good example of what is possible here.

This project, which began with the idea of transforming the methods of teaching of an entire school year, settled first on testing local changes on a more modest scale. With this in mind, it was decided to focus upon the production of three sequences of instruction with multi-media support, respectively in French, mathematics, and history-geography (an intermediate discipline combining these two subjects), corresponding to three weeks of the normal teaching programme and located at the heart of the eighth year, for the three streams of secondary education in Neuchâtel : maturity (pre-gymnasium), modern and pre-professional. These different streams lead either to further study or to employment and apprenticeships. It was also necessary to combine the periods of teaching using multimedia tools with periods of teaching by traditional methods, thus allowing some individualisation of the pace of learning but without pursuing one part to the detriment of the other, and also achieving a more adequate social integration of all the pupils. It was, thus, very clear from the outset that technological change should not be treated as an end in itself but a means to be measured against its contribution to these objectives.

The principal actors in the educational setting were necessarily the practicing teachers. They themselves conceived the scenarios that formed the starting point for the educational software, scenarios that were then translated by the programmers. Therefore the aim was to bring together the pedagogical competences of the former and the technological competences of the latter in the production of instructional sequences using the computer within a pre-defined pedagogical framework. It was also im-

portant that the entire approach was conceived as not only aimed at the realisation of pedagogical requirements but also as an opportunity to observe processes of learning and teaching and their transformation, this also necessarily being for all those involved an occasion for learning. The difficulties encountered and the shortcomings that occurred in the execution of this project should not be considered as failures but as steps in a process of creation, adjustment, understanding, diagnosis and evaluation.

The partners, the Department of Public Instruction and Cultural Affairs, BIP Information SA, and the Institute of Psychology, provided the management team or steering group the responsibilities of which were to look after the project finances, to seek out sponsors and partners, to create pedagogical teams, to record the process (minutes of meetings, correspondence, registrations, observations, notes), to organise the transcription of authors' scenarios and the development of instructional sequences with multimedia support, to produce the framework and conditions for testing the programmes in classrooms (recruiting pupils, keeping parents and other teachers informed, booking rooms, timetabling, etc.) and to provide reports on the experiment to the Department of Public Instruction and Cultural Affairs and to political policy makers.

The role of the management team, thus, involved both running and evaluating the project. There were two aspects of the evaluation. The first involved a self-assessment while the other required organisation of an external review by a mix of local and international experts. The external review unfolded in two phases, first a series of evaluations spread over the course of the project (involving four experts), and second a series of evaluations that took place at the end of the project (involving three experts, one of whom had been involved also in the previous phase). One of the experts was Swiss, the others bringing experience from respectively Belgium, France, Britain and Sweden. The experts' reports provided an account of their advice on the approach to creating the educational software, on the associated programmes and teaching procedures, on the organisational and political context of the project, on the three weeks operation in the classrooms, and on the generalisability and replicability of such an experiment. They were also able to modify the direction of the project and to influence the final self-assessment.

Last but not least our efforts were directed at trying to develop an intelligibility about what was involved in this project and at reflecting upon the tools of observation and understanding.

2. Creation of the programmes

The task assigned to teachers was to develop one part of the eighth year academic programme, with all sections brought together for three weeks, at the end of the academic year. The intention was that this part of the curriculum would not have been covered before testing the programmes in the classroom (this was likewise the recommendation given to other teachers). The objective was very much to begin from the knowledge and experience of the teachers. It was, thus, substantially their responsibility to develop the scenarios – which would later be translated by the programmers — and to decide in terms of their own aspirations the pedagogic approach to be adopted with these. They were to be guided by a pedagogic conception and not by the available technology. For them it was therefore very much a matter of identifying their needs rather than receiving instructions in the application of existing programmes.

Teachers having some familiarity with new technologies and likely to be interested in the project were contacted. Three teams were then formed, one for each subject, for French (Christophe Desvoignes, Anne-Christine Girod et Philippe Martin), for mathematics (Michel Botteron, Yves-Dominique Spichiger, Jean-Michel Lüthi), and for history-geography (André Allisson, Jean-Marie Gertsch, Silvio Nadig). Each team was, therefore, composed of three teachers, each of them being at a different career stage. In addition, for each subject there was an editorial committee consisting of two members (one of whom set in all three committees) – experts in methodology and individuals currently or formerly involved in teacher training. Their role was to read the authors' work and share their reactions throughout the creative process. The committee members were: in French : Gérald Rebetez and Claude Tharin; in mathematics: Denis Straubhaar and Claude Tharin; in history-geography: Jean-Daniel Goumaz and Claude Tharin.

The teams of teachers produced the scenarios and sent then either by mail or by e-mail to Anne-Maréchal. This person, whose job was to be an interface between programmers and teachers, was employed by BIP Info SA to help with exchanges and comprehension between these two parties. Her task involved editing the scenarios to facilitate their transmission to the programmers (who were located at some distance) and, in response to the technical constraints of programming (technological conception), negotiating modifications to the scenarios with the teachers while respecting as far as possible the latter's pedagogic and didactic requirements. This phase was not accomplished without some difficulties of communi-

cation and understanding, and required patience on both sides. Finally, working sessions were organised, bringing together the teams of teachers and programmers in order to aid the negotiations.

Let us now briefly describe the different programmes created by the teachers.

In French, the teachers had chosen to work on the module of the academic programme titled "the portrait" as it offered, they felt, an approach that was at once flexible and manageable. Their aim was to examine aspects of language use (lexicon, grammar, writing, comprehension and the study of texts). The contents of the module were organised around the study of several portraits along with various exercises on adjectives (function, agreement, etc.), and verbs (search for verbs, verbs of movement, etc,). At the same time the module incorporated structural aspects of the discipline ("pure grammar"), and enrichment of vocabularies related to portraits and to their semantic sphere (physical and psychological portrait), as well as the development of editing skills (style, use of synonyms, etc.). The linking strand was a comparison of a final with an initial text concerning the description of a friend. The educational software for French could be regarded as a "tutorial environment with drills and practice included". It involved a series of tasks linked by a common theme ("the portrait") intended to improve pupils' written expression and their acquisition of grammatical rules. It also incorporated the possibility of bringing in theoretical issues (rules of agreement, dictionary). The general idea of those who conceived it was that the work of pupils on the computer be complemented by other activities. In particular the intention was to develop oral aspects (mime, theatre, oral description of an acquaintance, guessing the identity of a person, expressions, etc.) and to combine paper excises with those on the computer.

In mathematics, the teachers chose to examine certain aspects of the geometry syllabus, not only because this is generally dealt with at the end of the school year but also because it offered potential for animation. In their view geometry was perfectly suited to such an exercise. The teachers had chosen as a linking theme the construction of a swimming pool. To this end the pupils were led to consider lengths, areas and volumes. At the start of the project they needed to develop a certain number of tools (finding the median, bisecting a line, measuring height, etc.) which they would require in order to make progress The educational software that the mathematicians chose to develop was a tutorial. It guided pupils' learning by demonstrating various procedures for construction and calculation (for example, the calculation of perimeters, areas and volumes or

the construction of medians, bisecting lines, etc.). These "lessons" were punctuated by exercises in which the pupils put into practice what they had just been shown. Sessions involving traditional (paper) exercises were combined with computer work. At various points, the pupils had to show the exercises they had completed to the teachers, and get a passing grade before being allowed to progress further in the programme.

In history-geography, the topic of agriculture was chosen ("present day agriculture and the agriculture of former times"). Teachers saw this as a topic that could be pursued from both a geographical and a historical perspective.

The authors had chosen to start with a concrete situation (a visit to a farm) and from there move back and forth between this real world example and sources of knowledge, help pupils familiarize with the topic while making it more concrete. During the visit, groups of pupils asked questions to the farmer. The information collected in this way was then entered into a data base in the programme, to complement data already entered by the authors. One further data base was made available, that of the Federal Office of Statistics. The pupils had to cover three themes, choosing the order themselves ("soils and products", "the race for yields", "farming and farmers : what place do they have today?").

The programme ended with a general test of twelve questions, and the award of a "diploma of agricultural knowledge". The history-geography software was a learning environment whose goal was provision of knowledge about agriculture organised in terms of the following specific themes: soils and products, yields, the farmer and farming today. It provided tutored sequences and exercises. The teachers developed a game-like aspect which allowed the tool to offer an "illustrated pedagogy" ("between play and the textbook", as they put it). They had deliberately included lots of images and minimised the amount of text involved; thus, some instructions and explanations were given orally (via headphones) so that pupils were not continually obliged to read.

Finally, written work was never combined with work on the computer.

The authors also introduced various round-table activities: identifying antique agricultural implements, tasting regional products, etc.

3. Classroom observations of three weeks of teaching with multimedia supports[2]

It seemed to us essential that the programmes created by the teachers be tested in the classroom by pupils.

Eighteen pupils, seven girls and eleven boys, participated in the project. They were all volunteers and had proved to be already familiar with computers. Each one of them worked on one computer. They were drawn from three different classes, following different curriculum tracks or streams: pre-professional, modern, and maturity. These pupils left their normal classes for one and a half days a week and during this time their classmates followed the same parts of the curriculum with another teacher. Two teachers were also present in the class throughout the experiment, the head of the class (who was also the chair of editorial committee for the relevant software programme) and a teacher-author in that subject. The distribution of teaching hours was as follows: four hours a week in French and mathematics, making twelve hours in total for each subject, and for history-geography three hours in the first week (this was devoted to the farm visit), and two hours in each of the two following weeks, making a total of seven[3].

Overall, we observed a strong motivation and high level of concentration among the pupils; as we came to realise, some did have difficulty taking any break at all while others left the room for one or two minutes in order to come back in as quickly as possible! As Pochon and Grossen (1994) suggest, computers have, in addition to their instrumental function, an evocative quality which may explain the fascination and infatuation that they can produce in the imagination, not only among children but also adults.

The pupils involved in the experiment did in addition demonstrate considerable patience and perseverance, particularly given various technical problems, which more than once required them to begin things again. Finally, they confirmed their enthusiasm for the project and their satisfac-

[2] Before the experiment moved to the classroom, a collaborator at the university, Marie-Jeanne Liengme-Bessire, observed pupils working individually, voluntarily and outside school hours, on the three programmes (these were the versions available in mid-March 2000, and thus the penultimate versions). The versions of the programmes tested in the classroom were the final versions.

[3] The "classical" weekly provision for each of these three subjects is higher. The SUMUME pupils covered the same programme in each of the subjects as their classmates but in less time.

tion at having participated through their responses to a questionnaire completed at the end of the experiment. In particular they stressed the calm climate and pleasant atmosphere in the classes: "everything pleased me", "and what is good is that you can have the instructions as many times as you want", "I had the impression that time passed too quickly" "we could move at our own pace; it was impossible not to work" " nobody was mad at the teachers and this made it much quieter", etc.

On several occasions we observed interactions among pupils in which two or three neighbouring children readily exchanged their work, between pupils who had reached the same stage but also between pupils who were respectively more and less advanced in the programme of work, and finally between pupils from different streams. The programmes were not initially devised by the teachers with this in mind but rather in terms of individual pupil-computer interaction (with the aim of encouraging individual work). It was interesting to see situations develop ing spontaneously in which pupils worked in twos or larger groups on certain modules and exercises, situations that allowed the development of argumentation and meta-reflection skills. It is indeed often the case that tools with multimedia supports, having been devised by their authors with certain usages in mind, are then employed by the users for quite other purposes (Perriault, 1989).

We were also able to observe among the children a tendency towards "corrective activity"[4] (albeit much less often than during the observations made outside the classroom; moreover this primarily occurred when children worked in pairs on the computer). This activity included looking for errors and spelling mistakes in the programmes, etc. The pupils seemed to be trying to measure themselves against the computer, or to trap the computer, behaviours resembling habits learned playing electronic games (Gay, Grossen & Pochon, 1991).

4. What was learned from the observations?

Having sketched the SUMUME experiment in broad outline, we will now describe some of the teaching aspects, starting with an analysis of the materials used (scenarios, programmes, notes, interviews, recordings, minutes of meetings, etc.). We will see that Information and Communi-

[4] Note that this kind of « treasure hunt » activity, well-known in psychology can also be exploited at the pedagogical level.

cation Technologies can re-energise learning situations, providing another role to teachers and other partners, allowing unstreamed classrooms through the individualisation of teaching, all the while bringing a flexibility and diversity to the tools available.

Different pedagogies

The three programmes devised by the teachers illustrate three quite different pedagogical approaches[5] and more particularly very different relations between work on the screen, written work and oral work across the three subjects. This diversity of approach was substantial and significant; by no means did use of the computer impose any uniformity of pedagogical style. In *French*, the computer work was complemented by written (paper) exercises and oral work (round-table exercises, mime games, etc). In *Mathematics*, the procedures presented in the programme (for example, calculating the perimeters and areas of different figures) and the techniques (how to draw a median or bisect a line) were verified through traditional exercises (on paper) and corrected by the teacher. In *history-geography* the data collected in the course of the farm visit allowed an enrichment of the programme data-base; this data-base was used to progress through the programme. In addition, the teachers involved found ways to provide other information in a more playful format.

Another role for the teacher[6]

Another impact of Information and Communication Technologies (ITCs) concerns the role of the teacher. Here the teachers typically took pleasure in discovering new aspects of pedagogy, which came entirely spontaneously out of this experiment. The use of methods of instruction based on ITC allowed them to re-examine their habitual practices as teachers. Equally, ITC enabled them to step back and reflect upon various didactic practices, methods and elements: the pupil's attainments, evaluation and assessment of pupils' work and their effectiveness, analysis

[5] Certainly these three do not exhaust the possibilities in these subjects!

[6] The operation had also required of those responsible for the administration of teaching (deputy director, director) to play an organsing role: they needed to defend the project to pupils, parents and teachers (for example, they had to explain the experiment to pupils and to their parents, to other teaching staff, occasionally having to convince some of them or remotivated others, etc.)

of pre-requisites, observation of pupils' strategies, etc. The multi-media tools were of such interest because they have a significant impact both upon representations of teaching and on interpersonal relationships, as we have already observed (notably Pochon, 1992; Pochon & Grossen, 1993, 1997; Schubauer-Leoni & Perret-Clermont, 1987; Perret, 2002; Perret & Perret-Clermont, 2001). The use of information tools also produces changes in space and time (Perriault, 1998, 2002), in particular by transforming the organisation and scheduling of working hours, rest periods, discussion time, individual and collective reflection , etc.

Even though the task for which they were made responsible placed the teachers in the position of authors of the programmes and, thus, left them free to proceed largely as they wished, the teachers were apprehensive that such an experiment would change their role. Actually this is exactly what did happen. By creating tools that developed into a system rather than the reverse, tools moreover that reflected their needs and the teaching methods of their subject, these teachers very quickly found that these tools were changing their methods of teaching, and doing so in an interesting way, offering them a different role. They found themselves encouraging, advising, and guiding their pupils. Partially being relieved of the burden of transmitting knowledge, they were able to adopt a more personalised supervision of their charges. Consequently, the computer was conceived as filling the role of "private tutor", providing pupils with basic knowledge, knowledge that was then enriched by the teacher. As one teacher put it "a computer will never replace a teacher, it will never do everything, but it allows one to save time and this time can be used for the benefit of other activities". In short, it allowed an individualisation of teaching and a mixing of pupils from different levels without any of them holding back the others. In addition, as one teacher recorded, he had realised for the first time that "one has the best view of everything from the back of the class". In fact, from this strategic perspective he was able to observe all the pupils without disturbing them, to be more attentive to what they were doing and more easily able to help them in case of difficulty. He no longer found himself in a position where he was necessarily the object of everybody's gaze and everyone's attention.

A heterogeneous classroom

Without denying that the three streams of children came to the SUMUME class with different baggage (different educational programmes, different educational objectives, different occupational aims), the inten-

tion was to individualise the teaching to allow them not only to coexist but to participate in genuine social exchange (avoiding *a priori* "castes" or segregation!). It seems that informational supports can make a contribution to this task by allowing those pupils capable of doing so to progress more rapidly and those who lack certain basics to fill these in and catch up with the others; there was therefore no question either of anyone being held back or of weaker pupils being marginalised. Instead there was considerable freedom to adjust the didactic approach to the level of the pupil[7]. In this regard, it is interesting to note that a pupil from the pre-professional stream, absent during the second week, was entirely able to make up the arrears in the third.

On the matter of this division of pupils into groups, classes, streams, levels or sections, numerous authors have taken an interest in the relation between the processes of educational selection and the self image or identity of pupils (Bell, Perret-Clermont & Baker, 1989 ; Vouilloz, 1981 ; Deschamps, Lorenzi-Cioldi & Meyer, 1982 ; Gosling, 1992 ; Marc, 1984 ; Monteil, 1989). There are in addition many studies showing clearly that, for pupils with difficulties, what the educational system may generally regard as a simple distribution of pupils into classes suited to their potential often appears to the pupils themselves to be a mark of personal failure. This educational categorisation, by placing some pupils in a disadvantaged and devalued position, influences their own perceptions and understandings and risks to become a point of reference or comparison for their educational experience. Pupils not only internalise this scholastic inferiority but also tend to accept the system's definition of their role, their competence and their value and its expectations about them.

It seems that the fact of bringing the pupils together, as the SUMUME made possible, allowed some pupils to construct or acquire access to a positive self image. Indeed, during the following academic year teachers spontaneously reported to us that the pupils from the pre-professional stream who took part in the SUMUME experiment had immediately struck them as more motivated. The young people themselves also expressed how valuable an experience was, to have been able to volunteer, to have been chosen (this sentiment was expressed by all the volunteer

[7] The number of observations available is certainly insufficient in such a small-scale experiment, run with volunteers, to allow one to make precise quantitative estimates of the pupils' progress, but the qualitative evidence and the learners' satisfaction are striking.

pupils), and finally to have participated in the experiment with the two other streams.

Development of cross-professional and interdisciplinary competence in the creation of a pedagogic product with multi-media supports

Even though, from the outset of this project, the three-sided collaboration involved did benefit from the intimate scale and autonomy of a cantonal educational system that eased contacts between the different participants, the challenge of the SUMUME project was to bring together different professional structures (those of politics, industry, the teaching profession, and the university) that do not normally work together and that to some degree misunderstand one another's cultures. This experiment was after all a novelty for all those involved!

To the extent that they found solutions to the problems encountered (specifications, the agenda, communication between teachers and programmers, etc.), the different partners in the project developed a greater shared understanding and discovered new ways of organising team work.

Equally, the actors developed competence in the particular business of creating a pedagogical product with multimedia support, and did so at several levels. These included the technical level (technological conception), the pedagogic level (change in the role of the teacher, adjusting to pupils' different rhythms, more personalised monitoring, pupils more active in their own learning, combination of work on the computer with other activities, more effective use of time) and the organisational level (implications for administration and school management, innovation and advocacy at the level of the educational system). The role of educational administrators was likewise somewhat modified. It fell to them to explain the project to pupils and their parents, but also to other teachers, and convince them all of its value, to organise the three weeks of class work (managing the timetable, arranging rooms, etc), and to sustain the morale of all the partners during those inevitable periods of tension that visit any innovative project.

Conclusions

Participation in the SUMUME project was an opportunity to acquire a certain amount of practical knowledge but also to develop insights at different levels.

At the level of functioning and organisation of a multi-professional and

multi-disciplinary group: One expected, it is true, an initial feeling of one's way towards a specification of the roles each party would play and there were occasionally difficult inter-group relations. All this could only be resolved by extensive discussion and give and take on all sides. This is the price to be paid for such an innovative approach when the partners involved do not initially know each other very well and have no prior experience of working together in new professional roles. They were able progressively to coordinate with each other and resolve the problems encountered. One can see born in these links new forms of professionalism; this is not, however, peculiar to secondary or high school education (Schürch, 2002).

At the level of organisation of the project: This was deliberately given over to teachers to ensure it reflected their needs, working conditions and didactic requirements. We expected that the programmes created in the three subjects would be different. There are after all distinct pedagogical traditions at the heart of each of these subjects, which were reflected in the teaching methods created. The programmes were then tested in the classroom by the teachers themselves.

At the level of teacher-pupil relations: We have seen that the teachers, encouraged in this by the programmes they had created (but sometimes without their realising it!), became organisers and advisors. Relieved of some of the responsibility for transmission of knowledge, they became involved in more personal supervision of pupils; this did not happen because it was imposed upon them.

At the level of allocation of pupils to the classes. It seemed appropriate to decide in favour of an individualisation of learning in order both to try to reduce educational failure and value those pupils with difficulties and at the same time to allow the "good" pupils to pursue the material and enlarge their knowledge at their own pace. It was nonetheless important in a diverse class to create a group spirit quickly (through ad hoc activities) and avoid the comparisons so commonly used with pupils (or between streams) of the form: "Who is already there?" or "Who has already done that?" It is all too easy to recreate "competition" if the teacher does not take care.

The entire approach of SUMUME has allowed not only the realisation of a pedagogic approach with multimedia supports but also observation of a transformation in processes of learning and teaching. It has made possible the accumulation of insights that can feed into the future training of teachers and organisation of schools.

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