

# Instrumental Enrichment: impacts upon learners who are deaf

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## Abstract

Feuerstein's Instrumental Enrichment (FIE) has positively affected the learning capacity of many populations; among those have been the effects with deaf and hearing impaired learners. The long history of negative expectations for deaf learners' intellectual potential is reviewed, together with later significant breakthroughs from meta-analytic research. Two reasons are provided for the relative rarity of implementation of FIE in deaf education. However, the often little-understood differences in the learning styles of deaf vs. hearing learners can explain how FIE has a uniquely relevant application to the cognitive needs of learners who are deaf. A summary of research studies on cognitive intervention programs provides a context for the introduction of FIE as a systematic and explicit intervention in different learning environments involving deaf learners; a synthesis of these studies indicates significant positive outcomes for FIE in that context in North America. A detailed description of a comparative international study of deaf learners in two countries further indicates that these positive effects may also be cross-cultural. A view of ongoing current and future training and implementation of FIE for deaf learners shows that FIE will persist as a cognitive tool in the hands of educators of the deaf.

## Keywords

Deaf, Hearing impairment, Cognition, Feuerstein Instrumental Enrichment Programme, cognitive processing

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## Introduction

In the well-deserved issue of this journal to honor the memory and monumental works of the outstanding cognitive psychologist, Prof. Reuven Feuerstein, the impact of his Instrumental Enrichment program (FIE) (Feuerstein, 1980) on learners from many different populations is highly appropriate for us to examine—in this instance, the impacts upon the learning capacities of learners who are hearing impaired. Because deafness is considered to be a “low-incidence disability” due to its relative rarity in most populations, the number of trainings and implementations of the FIE program for the needs of deaf learners have necessarily been more limited than for many other populations, e.g., typically-developing learners, learning-disabled learners, and developmentally challenged learners, to name only some.

However, a number of empirical studies since the late 1970’s have documented the positive effects of the program on this special population. Cognitive intervention programs in general have been applied only from time to time in deaf-education settings for one principal reason—the overall focus among educators of the deaf and hard of hearing for many decades has been on enabling them to attain some form of basic literacy for their students, with the result that relatively little time has been devoted to other subjects in the curriculum. An important factor is that more than 90% of deaf learners are born to hearing families and thus grow in their early years without benefit of any language. The profoundly or severely deaf child cannot hear and thus is blocked from auditory input, and the great majority of hearing parents of deaf children until recently did not learn sign language to use with their deaf child—in other words, these children have not had an opportunity to develop another modality of expressive and receptive language, i.e., visual instead of auditory, until and unless they have entered a formal school program which uses sign language (often not until age 5 after several critically important developmental years have been neglected).

Why, then, has the adoption of FIE been relatively inconsistent in deaf education? Two reasons may be found. First, it is not surprising that the training and implementation of FIE among classroom teachers for deaf students requires an unusual commitment in order to be willing to “sacrifice” valuable literacy-development time for a focus on thinking strategies in the classroom. The fact is, however, that the research reported in this article indicates that the faithful implementation of FIE among deaf learners actually

provides the cognitive prerequisites necessary for literacy, although not in an obvious way at first; for example, the development through the FIE program of such thinking skills as precision, comparison, analysis, systematic approaches to problem-solving, and decoding (among others) has a direct positive relationship to the process of becoming literate. Therefore, adoption of FIE by teachers of deaf students requires some initial risk-taking in order to “make time” for a cognitive-strategy focus. The studies reported below provide evidence that such “risk-taking” is indeed worthwhile and yields valuable eventual dividends to the deaf learner.

A second reason for inconsistent adoption of FIE is found in nearly all potential FIE classrooms (regardless of the students’ special needs) -- how to “justify” taking classroom time for cognitive intervention when a program such as FIE does not clearly appear to “fit” the subject matter of the curriculum in any obvious way—its content is not history, science, social studies, literacy, etc. FIE is deliberately designed to be generally content-free. It is not clear at first, then, to the uninitiated classroom teacher how cognitive strategies can possibly assist with any learning since the effects are indirect and not immediate. For nearly all classroom teachers, then, adopting FIE after the required extra training as a mediator is a kind of “act of faith” by teachers. And in the USA, many states are tying teacher evaluation to student performance on annual examinations, thus putting more pressure on teachers to avoid deviating from the regular curriculum. For both of these reasons, then, it is understandable that the implementations of FIE in classrooms with deaf students has been somewhat limited.

In the pages which follow, we provide first a summation of the historical view of attitudes toward the intelligence of deaf learners ( a sad chapter in educational history), followed by a summation of a number of research studies carried out with deaf learners and several cognitive interventions including FIE, followed in turn by a detailed description of a particular international comparative study of FIE with deaf learners, and then we finish with a cautious look at the potential future for applications of the FIE program in the field of deaf education, including current projects under way with deaf learners for whom data are yet still to be collected.

All of these activities are testimony to the legacy of Reuven Feuerstein and his contributions to the education of all learners.

## Historical overview

As in some other special-educational domains, attitudes toward deaf learners have a long and, for the most part until recently, sad history. We can, through inference, trace back some of these attitudes into antiquity. For example, in the Old Testament is an admonishment to the Hebrews not to curse the deaf; it is a small leap to infer that such an admonishment would not have been given if hearing citizens had not in fact been cursing the deaf—forcing deaf persons to be hidden or remain relatively isolated from the rest of society.

Later we find that Aristotle—that giant of thought from Ancient Greece—considered the ear to be the organ of instruction. Again, it is a small leap to infer Aristotle’s probable view that if a person could not hear, then she/he could not be taught. Interestingly, if we jump forward in Western European history, we find that in the 16<sup>th</sup> century and afterward, the right conclusion was drawn for the wrong reasons—some successful attempts had been made by that time in some Western European countries to teach moderately deaf persons to speak (probably persons with enough residual hearing to make speech imitation possible for some). Thus it was then concluded that, after all, some deaf persons could in fact be taught and therefore may have “intelligence.” Again, we see the confusion by the hearing world that the ability to articulate speech correlates with intellectual potential.

Then we pass through a period of historical backsliding once again. If we jump ahead to the early 20<sup>th</sup> century, we find that in the 1920’s a report from the USA’s National Research Council (an arm of the then-young National Academy of Sciences) said that deaf learners were two-to-three years “retarded” (National Research Council, 1925); the use of that term was indeed unfortunate because it could be taken as referring to mental retardation as a label, which then implied lowered expectations. The report probably meant that deaf learners were “behind” their hearing counterparts, which would be understandable if deaf persons had been prevented from linguistic experiences. Later in the 20<sup>th</sup> century, we find that even some well-regarded special educators were pronouncing that deaf learners were intellectually “inferior” (Pintner, 1941), and only capable of concrete, rather than abstract, understanding (Myklebust, & Brutton, 1953).

In fact, it was not until the 1960’s that two breakthroughs occurred, after centuries of misunderstanding and lowered expectations. One educator

published a research article declaring (finally) that no differences existed between deaf and hearing learners' ability to conceptualize (Rosenstein, 1961). Then a psychologist (Furth, 1964; 1973) from outside the field of deafness published an important paper in which he stated that the problem was not with deaf persons' performance, but rather was due to the tests that were being used to assess them—correctly putting his finger on one of the critical problems in the field. Shortly afterward, another highly regarded scholar in the field of deaf education (Vernon, 1968) carried out a meta-analysis of a group of research studies that had been done earlier on particular cognitive skills in deaf learners; he concluded that, when considered together, the body of research now showed that deaf learners have the same cognitive potential as hearing learners, even though they demonstrate some different strengths and learning styles from their hearing peers. The key word here is “potential”—meaning that deaf learners could achieve on a par with hearing learners, but that certain actions had to be taken in order to achieve that equity. This finding laid the foundational rationale for adopting the Feuerstein view of intelligence as dynamic, not static, in deaf education as in all other realms of education.

In the matter of learning styles, it has been inferred (Marschark & Wauters, 2003) that deaf learners are not simply hearing learners who cannot hear. The use of a visual language, such as American Sign Language, “wires” the brain in a different way, such that many deaf learners have a relative strength compared to hearing learners in simultaneous processing—because the brain needs to process visual communication in a simultaneous manner. On the other hand, hearing learners who use an auditory language tend to be more adept than deaf learners in sequential processing because one processes an auditory language sequentially.

The powerful conclusion that deaf learners have a full range of cognitive potential has still not completely permeated the field of deaf education, but specific attempts were then made during the latter 1970's and beyond to carry out pro-active cognitive interventions with deaf learners as means of providing the cognitive strategies that they were missing, so that their potential could indeed be realized. FIE has been one of the primary tools in a number of those interventions, as we shall review below. Those efforts continue at the present time and represent a most hopeful trend in deaf education.

## Cognitive interventions

Deaf cognition has been subjected to many years of empirical study. But with the establishment of the principle that deaf learners have the same range of cognitive potential as hearing learners (e.g., Furth, 1964; Vernon, 1968; Meadow, 1980), a number of studies occurred during the 1980's and 1990's in relation to the enhancement of cognitive development in the deaf learner.

The studies have involved the use of several different programs of cognitive-strategy instruction, a number of which used the FIE Program, to investigate the effect of explicit and systematic classroom focus on the teaching of higher-order cognitive strategies and their application to school subject matter.

A study by Rembert (1985) used the Philosophy for Children program with deaf students and found that students learned to express themselves more clearly in interpersonal communication, increased in understanding of meaning in their reading comprehension, and improved in their acceptance of others' opinions; these results are understandable because of the emphasis on dialogue in that program.

Let us look now at studies which explicitly included FIE. In one of these studies (Berchin, 1991), eighth-grade students at the Lexington School for the Deaf in New York City used the FIE program over a period of four years. It was found that FIE students on the Stanford Achievement Test for Reading and Mathematics Problem-Solving, after using FIE, showed the following increases when compared to national data that indicate an average growth of about 3 months per year without using FIE: 22% of the students increased 3 or more grade levels in Reading Comprehension, 14% increased 2 grade levels, and 33% increased one grade level; on Mathematical Problem-Solving, 36% of the students increased 3 or more grade levels, 17% increased 2 grade levels, and 19% increased 1 grade level. These data are noteworthy in light of the fact that there were 24 different home languages in students' families, and 80% of the students qualified for governmental assistance as a result of family poverty (Keane, 1985). Keane found that when deaf students have FIE experiences, mediation results in measurable cognitive modifiability. Keane and Kretschmer (1983) had also designed a study in which an experimental group of profoundly deaf students from hearing families were contrasted with a similar group of controls; the experimental group were exposed to mediated intervention on Feuerstein's Learning Propensity Assessment De-

vice (LPAD). The experimental group performed significantly better in transferring their learning on defined cognitive parameters.

Another study by Dietz(1985) combined the use of FIE with the computer program LOGO, and found that students became more independent, were more persistent in dealing with challenging problems in mathematics, used better planning behavior, were more willing to explore on their own without needing continuous feedback from their teachers, and developed more positive attitudes toward school.

Other studies which support the acquisition of cognitive strategies by deaf learners through FIE's mediated-learning interventions include those by Krapf (1985) and Parasnis & Long (1979).

A study with high-school age deaf students (Martin & Jonas, 1986) was designed to examine the effects of intervention using FIE methods and materials. At the Model Secondary School for the Deaf(MSSD) in Washington, D.C., six FIE instruments (analytic perception, comparison, projection of visual relationships, spatial relations, instructions and classification) were used over a two-year period with an experimental group of secondary-level deaf//hard of hearing students by contrast with a similar group of control-group students. The specially trained teachers at least twice a week incorporated a series of visual, verbal, and geometric activities into regular subject matter; helped students solve these problems; conducted metacognitive discussions; and then discussed how the students' mental strategies within these problems would be used in subject matter.

The gain by the FIE group on the Raven's Standard Progressive Matrices (Raven, 1960) exceeded that of the control group at a .02 level of statistical significance. The results of the Reading Comprehension subtest of the Stanford Achievement Test for the Hearing-Impaired (SAT-HI) indicated that the experimental group exceeded the control group at a significance level of  $p < .05$ ; FIE students improved by 15.6 scaled points. This significant improvement in reading comprehension can be explained by the added focus through FIE on the prerequisite literacy skills of comparison and projection of relationships. The FIE instructional emphases on precision, taking time to think (restraint of impulsivity), and checking one's own work would further explain this important gain in the FIE group of students. Scores of experimental subjects on the SAT-HI mathematical computation and concepts subtests indicated a statistically significant difference demonstrating greater progress by FIE students in the acquisition of math concepts by the end of

the experimental period as compared to the control group. In addition to the use of the Raven's Matrices and the SAT-HI, real-world problem-solving situations were presented for written responses. Results indicated that FIE students improved in thoroughness, detail, and sequence in their responses to problems when compared to the non-FIE students. In addition, let us refer back to the earlier statement that many students who have been profoundly or severely deaf from an early age and are users of a visual language, tend to experience challenges in sequential vs. simultaneous processing. The fact that FIE addresses sequencing would at least partially explain some of the improvement of the experimental students in literacy because the relatively weaker area of sequential processing has been addressed.

Finally, teachers other than the FIE teachers were asked to rate all experimental and control group students' cognitive behavior before the beginning of the experimental period and again near the end of the project, using a five-point scale of behaviors which reflected the major goals of FIE. Because the reporting teachers were *not* those involved in the teacher-training group, they had no specific preconceived expectations for any changes in student behavior. The rating of experimental group students by teachers other than those in which that group had their FIE experiences found the following trends in experimental students:

- A tendency to move directly to expected tasks.
- Giving relevant and complete answers.
- Increased willingness to help others in class.
- An increase in working well with others in a group.
- An increase in "consideration of others' feelings" and increase in "listening" behavior.
- A decrease in impulsivity.
- A reduction in involvement in non-productive arguments.

Positive results from another FIE intervention were also reported from implementation of FIE at the Western Pennsylvania School for the Deaf (WPSD) (Craig, 1987). As with the MSSD study, intervention took place in classes of students; thus, the classroom was again the unit of intervention, and students were not individually assigned randomly to treatment groups. Over a two-year period, secondary-level students in the experimental classes were provided with systematic instruction in cognitive skills for at least two class periods per week using FIE, while the comparison groups received only the

regular academic instruction (e.g., reading, language, mathematics) which was usually scheduled at that time. The WPSD study included 20 experimental and 20 control subjects. Results from the WPSD study (Craig, 1987) showed that the students trained in FIE made significantly higher gains than control group students on the Reading Comprehension subtest of the SAT-HI. Over the 2 years, the FIE-trained group made a scaled score gain of 14.7, compared to the non-FIE group gain of 9.5 ( $t = 3.83$ ;  $p < .01$ ). For the FIE group, this result represents a Grade Equivalent (GE) gain of 1.68 or (0.84 per year), almost tripling the average yearly gain in SAT-HI Reading Comprehension reported for deaf students nationwide who have not experienced the FIE intervention (Trybus & Karchmer, 1977). The WPSD experimental group also gained significantly higher scores on the Minnesota Paper Form Board (a measure of spatial problem-solving) than did the controls ( $t = 3.23$ ;  $p < .05$ ). .

Other successful implementations of the FIE program have taken place at The Learning Center for the Deaf in Framingham, Massachusetts and at the North Carolina School for the Deaf at Morganton. For digests of studies related to cognition and deafness, including interventions through FIE and other techniques, see Martin (Ed.) (1985) and Martin (Ed.) (1991).

## **An international study**

The above studies have largely occurred in North America, within the framework of a culture that values independence, originality, and systematic approaches to problem-solving. An important question arises as to the cross-cultural applicability of these same effects on deaf learners in other countries. Other cross-cultural studies of thinking in education provide additional perspectives and are summarized in Martin, Craft, & Zhang (2001).

A cross-cultural international comparative study using the FIE Program was then devised, involving cohorts of deaf students in the United Kingdom and the People's Republic of China (Martin, Craft, & Zhang, 2001).

The major objective of this investigation was determining the degree to which the positive effects of cognitive-strategy instruction for deaf learners are international or cross-cultural, given similar conditions of teacher training, application of methodologies, and application of specific material. Cognitive strategies in this study followed the Feuerstein methods of specific practice in particular thinking skills (e.g., comparison, categorization, etc.) in

which the learner first uses content-free paper-and-pencil exercises to learn about and rehearse the strategy, followed by metacognitive discussion about the process just used, and practice in applying that particular strategy to some aspect of subject matter study within the regular curriculum.

The procedure in this study first established a teacher-training sequence which included a theoretical overview of critical and creative thinking skills, followed by a discussion of some recent theoretical topics in the field such as multiple intelligences, divergent thinking, cognitive modifiability, metacognition, and the role of teacher as cognitive mediator. The sessions continued with the demonstration of particular critical thinking activities adapted from the work of Swartz and Parks (1994) in addition to FIE. Specific cognitive strategies taught to the teachers included comparison, categorization, sequencing, creating instructions, and finding multiple solutions to the same problem. Themes of the critical thinking and problem-solving activity in the teacher-training sessions involved sequencing, comparison, categorization, cause-and-effect, prediction, and identifying reasons and conclusions.

Sessions related to the teaching of creative thinking made use of aspects of the work of Craft (1997), Gardner (1980), and Sternberg & Lubart (1991). Teacher-training tasks involved reflecting on the creative process, overcoming barriers to creativity, the importance of teachers as adults freeing their own creativity in order to become teachers of creative thinking, and developing and sharing of model classroom activities built on such themes as risk-taking, applying innovations, multiple possibilities, and what-if situations.

The materials and teaching procedures which the teachers used with the experimental classes consisted of some non-verbal paper-and-pencil exercises, some discussion-prompter topics, some group investigation tasks involving the solving of a problem or the creation of an innovative idea, and some enactive activities in order to illustrate an abstract idea. FIE activities formed the majority of the classroom activities by these FIE-trained teachers.

In each implementation for each country, teachers were asked to incorporate planned explicit thinking activities (problem-solving/critical and creative) over a 6-month period between two and three times per week, with an average of 30 minutes on each occasion devoted to explicit thinking-skill activities. The results of this international comparative study were:

1. The lack of difference between the two groups—England (presumed to reflect a cultural base that is similar to the USA) and China—in reasoning skills, seems to indicate that although the style of problem-solving may be different, the outcomes in the present study are similar across the two countries and the USA, in reference to the Martin and Jonas (1985) study cited earlier.
2. The complexity of demands on some of the critical and creative thinking activities involved multiple steps—problem-identification, development of alternatives, selection of most appropriate solutions, and defense of the solution chosen. The study provided relatively little time for the acquisition of those complexities (six months); it is to be expected that any results obtained in such a short period would be notable, given that the discoveries, insights, and refinements needed may well require further time.
3. In both the China and England groups, the cognitive activities appear to have resulted in heightened student interest, as evidenced by both teacher reports and classroom observations; such an effect could have a further salutary effect on student interest in school in general.
4. Student use of cognitive vocabulary appears to be an unplanned effect of the thinking activities, but it is understandable because discussion in the intervention program often refers to cognitive processes—a metacognitive effect. Teachers report that this terminological use was spreading also to the times of the school day other than when thinking strategies were the overt explicit emphasis.
5. While the study did not explicitly intend to compare deaf and hearing learners within the same sample groups, nonetheless an artifact of seeking participating teachers in the England cohort resulted in a combination of deaf and hearing learners in those groups. Their pre- and post-test data were analyzed both as a combined group, and separately (deaf vs. hearing). A striking result is that there were no measurable differences in the outcomes for deaf vs. hearing learners. This outcome is particularly encouraging inasmuch as it adds to the evidence that deaf learners have a potential which is similar to hearing learners.

6. The research design originally posited that the factor of communication modality might make a difference in outcomes---that the use or non-use of sign language would affect the results. It was known in advance that teachers in England (and in the previous study in the USA) used sign language regularly in the classroom with their deaf learners, while in China the teachers emphasized oral methods with some sign-supported speech. However, as was indicated in the report of the results, the experimental teachers in China actually adopted considerably more regular use of sign language than they had done before; this serendipitous result was attributed to the fact that during their training period, the trainer had consistently modeled the use of sign language.
7. Similarly, the research design had posited that the view of the learner might affect the outcomes of cognitive-strategy instruction; it had been previously established through observation that teachers in England (and in the earlier study in the USA) approached instruction with a fundamentally constructivist viewpoint, seeing the learner as participatory and fostering significant student-student and student-teacher interaction, while in China the dominant style had been didactic with the teacher being the source of knowledge and the learner as the recipient. However, the China experimental teachers during the experimental period adopted a significantly more participatory style, as recorded by the outside observers using the Classroom Observation Scale (Winocur, 1991). Again, the modeling of this approach in the teacher-training period could be the origin of this change.

The above studies with FIE, when taken together, demonstrate that such explicit classroom intervention with appropriately re-trained teachers, use of appropriate methodology, and use of specially designed materials, result in measurable positive effects on specific cognitive skills in deaf learners when compared to deaf students who do not have this classroom experience.

The overall conclusion from all of these cognitive intervention accounts is that not only is it clear that deaf students have cognitive potential which can be realized, but also that the FIE program is one of the prime methods of intervention which has led to these educational successes.

## **The present and future**

Efforts to pro-actively enhance the cognitive development of deaf and hard of hearing learners continue. Among those is an on-going project at the National Institute for the Deaf in Worcester, South Africa. In that extensive project, more than 35 teachers have been trained by the author at the same school in either FIE Basic or FIE Standard; they are implementing the program with populations who come not only from South Africa but also neighboring countries where they would have no opportunity for cognitive education. The project has a full-time on-site FIE Coordinator—an essential component to ensure that teachers have a support system as well as having a professional with full expertise who can provide models for mediation and assist the teachers with their implementation for consistency across the institution. Data on this project are being collected as part of a doctoral dissertation research.

Separately, at a smaller school for the deaf in Western Massachusetts, USA, several teachers have begun training in FIE Basic for implementation with pre-school and young elementary-age students during 2015. At another larger school for the deaf in Connecticut, planning is under way for faculty professional development in FIE in the next two academic years; interestingly, this project has resulted from the fact that the Superintendent had been a deaf student who had his own FIE experiences as a student himself at one of the New York-based FIE projects during the 1980's—thus, a second generation is planning to perpetuate the effects of the program. Other projects with deaf learners may be under way elsewhere.

The timeliness for inclusion of cognitive strategies in teacher education has been underlined at the international level. Davila (2000), in the keynote presentation at the 19th International Congress on Education of the Deaf, listed among the current needs in the field that teachers must help deaf learners with reasoning and problem-solving skills. Marschark (2000), in a review of what is and is not known in the field of deaf education today, stated that without an understanding of the full complexity of cognitive abilities, special education teaching methods can “never be special”. Svartholm (2000), in discussing how teachers must make a “bridge” between sign language and the local written language, stated that teachers need “extra training” in critical thinking.

A clear curricular implication emerges: regular and systematic infusion of cognitive strategies should become a part of the curriculum for deaf learners at all ages. Methodologies for infusing higher-order thinking now should also become part of the repertoire of not only current in-service teachers through professional development, but also of teachers-to-be during their pre-service preparation. In turn, teacher-education faculty must themselves become adept at such strategies and knowledgeable about their importance in order to prepare their future teachers in these strategies. FIE is clearly the most widely tested and logical tool for this work with deaf students.

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