

APPLICATION OF INSTRUCTIONAL SYSTEMS DESIGN TO DEVELOP AND IMPLEMENT AN EARLY INTERVENTION MODEL

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ABSTRACT

In this study, an early intervention model was developed by applying instructional systems design and implemented on 45 and 30 at-risk and developmentally delayed infants and toddlers aged 4-33 months, who were assigned randomly to the experimental group and control group. The efficacy of the early intervention model, as seen from the Bayleys scale of infant development (BSID), showed striking performance gains in the experimental group on mental age (3.57), mental development index (5.03) and deviation mental quotient (6.17). The t-test measures on mental age were found significant for both experimental ($t=5.70$) and control group ($t=8.9$), while it was significant in the experimental group only on mental development index ($t=4.09$) and Deviation Mental Quotient (2.64). The intervention gains indicate the efficacy of an early intervention model and has implications for application within the community at large.

INTRODUCTION

There are varied biological and environmental risk factors that are detrimental and therefore impede the normal course of development in children. These may occur during pregnancy, delivery and early in life, resulting in deficits of the central nervous system. These infants are in risk for a substantial development delay, if timely and appropriate intervention is not provided. Children with developmental delays display deficits in one or more areas of development like motor, sensory, speech, language, communication, and cognition, social and emotional. Hence, early intervention is crucial in bringing about secondary prevention in the affected population.

The existence of numerous methodological problems has posed significant challenges in the ability to establish unequivocal statements regarding the efficacy of early intervention (1, 2, 3, 4, 5). The results of two meta-analyses (6,7) as well as more traditional reviews of effectiveness (8) support the generally held opinion, that early intervention programmes are

indeed effective, producing average effect sizes falling within the range of one half to three quarters of a standard deviation.

Within the framework of early intervention programmes that are essentially parent focused, the involvement of mothers as participants in the training programme is an important aspect of the programme feature.

Instructional Systems Design and Early Intervention

Instructional systems design is based on an open systems theory. An open system receives inputs from the environment, transforms them through operations within the system, submits outputs to the environment, and receives feedback indicating how well these functions are carried out. According to Hackos and Redish, “The use of instructional systems design helps to draw conclusions about how the training works. The main goal to design a product is to adapt the techniques of learning to practical realities for working out suitable and most appropriate methods. Adapting these techniques to practical realities is the basis for the instructional design” (9). The social context that helps to facilitate the child’s development is defined largely by the children’s interactions with their primary caregivers. Developmental systems are so intertwined, that factors influencing any aspect of development, whether internal to the child or part of the child’s physical or social environment, have broad implications (10). It is through the caregiver that the young child gains access to the environments. It is against this background, that an early intervention model was devised by applying the instructional systems design process, to study its impact in infants and toddlers with developmental delays.

The objectives of the study were to:

1. Devise an early intervention model by applying the instructional systems design process.
2. Implement the early intervention model on infants and toddlers with developmental delays
3. Study the efficacy of the early intervention model.

METHOD

Sample

The children attending Early Intervention Services at National Institute for the Mentally Handicapped (NIMH), Secunderabad, India, were selected for the purpose of the study. Sample I comprised the children, while sample II were mothers of these children. Sample I, (N) comprised of 75 children with developmental delays in the age range of 4-33 months.

A total of 45 subjects were randomly assigned to the intervention group and 30 subjects to the control group. The experimental group of Sample I received both the general cognitive stimulation and early intervention model exclusively designed for the research, while the control group received only the general cognitive stimulation which is part of the NIMH early intervention programme.

The experimental group of Sample II mothers were trained on implementing the early intervention strategy, while the control group did not receive this intervention.

Tools

The tools used included the personal data schedule to information on demographic information about the child and the mother; developmental screening tool of Bharadwaj (11); Bayleys Scale of Infant Development (BSID) standardised on Indian children by Dr. Pramila Phatak (12); the Battery of Problem Solving Tasks (BPST) developed and validated by the researcher on 120 children consisting of 35 problem solving tasks from 0-36 months of age; the Mother-infant interaction observational checklist.

Procedure

The components of the early intervention model comprised of problem solving tasks and mother-child interaction. Enhancing problem solving skills provides a means for teaching children “to think”. Another emphasis of this study was to train the mothers in helping them to understand the child’s development by involving them as facilitators. The early intervention model designed as per instructional systems design process consists of six levels.

Level I-Conduct Needs assessment

A need is a performance gap separating what people know, do, or feel from what they should know, do or feel to perform competently (13). A need assessment of the parents of children with developmental delays revealed the significance of devising the early intervention model. This kind of training that is easy to implement with the available resources in the home environment and can also facilitate optimal development of infants and toddlers, was the need expressed by parents.

Level II- Assess relevant characteristics of the learners

The two categories of learners in the present study were, 1) children with developmental delays and 2) mothers of these children. A broad range of the learner's profile is essential, as the needs of atypical population are addressed. Learner-related characteristics, decision related characteristics and situation related characteristics of children and mothers in this study are given in Table 1.

Table 1. Learner characteristics for obtaining the performance outcome for children and mothers

Learner characteristics	Description of profile
Learner related characteristics	Child <ul style="list-style-type: none">• Children with developmental delays• Variations with respect to age, etiology, birth weight, gender. Mother <ul style="list-style-type: none">• Maternal education.
Decision related characteristics	Child <ul style="list-style-type: none">• To improve problem solving skills in children with developmental delays. Mother <ul style="list-style-type: none">• To empower the mothers as facilitators for improving problem solving skills of their children.

<p>Situation related characteristics</p>	<p>Child</p> <ul style="list-style-type: none"> • Developmental process is hastened when opportunities are provided through psycho-ecological intervention strategy. <p>Mother</p> <ul style="list-style-type: none"> • Play a predominating role in fostering child's developmental process.
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Level III- Understand the learners, to judge what they know and what they do not know

This was done by administration of Bayleys Scale of Infant Development (BSID) and the Battery of Problem Solving Tasks (BPST) for the child. From the observations of mother-infant interactions which were coded, the mothers' training needs were determined.

Level IV-Statements and performance objectives for child and mother

A performance objective is an expression of a desired result of a learning experience. It describes the desired results.

At this level, the training programme was geared to help the learners in understanding the tasks they must learn to do. For the children, the performance objectives were decided by administering the BPST. For the mothers, the performance objective was to modify the interactions with the child and providing training for implementing the problem-solving task with the specified material.

The instruction designed for the mothers and children is presented in Table 2.

Table 2. Instruction designed for children and mothers

<p>Child</p>	<p>Mother</p>
<ul style="list-style-type: none"> • Improving problem solving skills. 	<ul style="list-style-type: none"> • Improve knowledge • Improve parenting skills • Understand child's development.

<ul style="list-style-type: none">• Four target items for each subject were given as performance objectives.	<ul style="list-style-type: none">• Training by researcher on how to interact Demonstrating to mother on how to teach the problem-solving task.• Set guidelines and written instructions to follow at home.• implement at home using STEPSS* package
<ul style="list-style-type: none">• To arrive at solutions for the given problem solving task	<ul style="list-style-type: none">• to help child to achieve the task.

*STEPSS package-The manual titled “Strategies to enhance problem solving skills (STEPSS)” prepared by the researcher for each problem solving task, so as to help the mother to implement the target at home.

Level V-Designing training

For the early intervention model, the instructional strategy used was psycho-ecological intervention strategy, which is emphasised because the focus is on child, mother and environment. The components of psycho-ecological instructional strategy are:

- Task analysis-For each of the problem solving task a procedural manual entitled “Strategies to enhance problem solving skills (STEPSS) was prepared for the purpose of the training.
- Target related interactions- mothers were trained on specific interactions to help child to solve the task.
- Target specific materials – For each task, specific material that are most commonly available in Indian homes was selected.

Level VI-Performance outcome

In the present study, performance outcome was measured using the Bayleys Scale of Infant Development (BSID), which gives the mental age (MA) and mental development index (MDI).The Mediated learning index (MLI) was derived from Battery of Problem Solving Tasks (BPST), Various statistical measures both quantitative and qualitative, were used to test the efficacy of the early intervention model.

RESULTS

Performance outcome of children

The efficacy of the early intervention model was determined from the intervention gain from pre to post test, as seen from the difference on mental age (MA), mental development index (MDI) and Deviation mental quotient (DMeQ), which are derived from BSID. The mean performance at pre and post test in experimental and control group is given in Tables 3a and 3b.

Table 3a. Mean performance of children before and after intervention in experimental group

Performance measure	N	Pretest mean +S.E mean	Post test mean +S.E mean	Mean difference	t-value
Mental age	45	8.23+0.63	11.81+0.83	3.57+0.62	26.833**
MDI	45	54.88+2.14	59.92+2.43	5.03+1.22	4.099**
Dmeq	42	31.09+3.48	37.26+4.02	6.17+2.33	2.649**
BPST	45	6.63+0.66	11.20+0.7	4.57+0.16	27.930**

**Significant at .001 level

Table 3b. Mean performance of children before and after intervention in control group

Performance measure	N	Pretest mean +S.E mean	Post test mean +S.E mean	Mean difference	t-value
Mental age	30	6.99+0.71	8.77+0.80	1.78+0.2	8.9**
MDI	30	42.09+1.57	41.29+1.45	-0.85+1.22	.694
Dmeq	28	14.65+2.00	13.05+2.00	-1.59+1.51	1.04
BPST	30	3.47+0.56	4.90+0.64	1.43+0.15	9.607**

**Significant at .01 level

As evident from Tables 3a and b, the subjects in the experimental group displayed more striking intervention gains as seen from the mental age and mental development index. The substantial gains as seen from the mean differences of MA (3.57), MDI (5.03), DmeQ (6.17) and BPST (4.57) by experimental group when compared to control group MA (1.78), MDI (-0.85), DmeQ (-1.59) and BPST(1.43), is indicative of the efficacy of early intervention model.

The pre to post measures were highly significant on MA ($t=26.833$), MDI ($t=8.9$), Dmeq($t=2.64$) and BPST($t=27.93$) in the experimental group, while it was significant only on MA ($t= 8.9$) and BPST ($t=9.607$)in control group. The significance on MA and BPST in the control group could be attributed to the general cognitive stimulation given as part of the NIMH early intervention programme.

Performance outcome of mothers

As interactions of mothers formed an important aspect of the present study an attempt was made to provide a comprehensive evaluation of maternal behaviour during mother- child interaction and its effect on the child's ability to solve the given problem. The interactions and verbalisations by the mother were identified as an important aspect of psycho-ecological intervention strategy, which was discussed as part of designing the training programme.

The interactions were coded, by observing the mother and child in a play situation where the mother helped the child to solve the problem-solving task. The mothers were trained after initial assessment by the researcher, to modify the interaction behaviours as per the observations. The interactions were observed and coded again after the training. Maternal task related interactions were coded as per the checklist of interactive behaviours. Table 4 gives the difference on mean percentage of interaction behaviours provided by the mother, before and after the training.

Table 4. The mean percentage of interaction behaviors before and after intervention

S No	Interaction behaviors	Mean percentage		
		Before	After	Difference
1	Non verbal and verbal response	78	85	7
2	Calling for infants attention	84	92	8
3	Showing object	82	94	12
4	Gestural imitation of child behaviour	55	74	19
5	Assisting to solve the task	47	84	37
6	Description of the task	65	88	23
7	Positive affect	88	94	6
8	Providing verbal clue to assist recall	52	78	26
9	Providing for trial and error manipulation	65	78	23
10	Verbal statements of praise	85	91	6
11	Reinforcement and explanation	57	89	32
12	Modification to allow success	63	89	26
13	Following the sequence of steps given in manual	48	91	43
14	Sustaining interest by modifying cause and effect sequences	65	77	12
15	Interpreting child's needs	87	89	2
16	Building expectations	44	71	27
17	Making appropriate seating arrangement	58	78	20

Mothers required more input with regard to assistance to solve the task (47%), description of task (65%), providing verbal clue to assist recall (52%), following sequence of steps (48%) and building expectations (44%). Mothers also reported a marked change after training on

these behaviours. The difference indicated the change in interaction behaviours which was 37%, 23%, 26%, 43%, and 27% respectively.

DISCUSSION

In the present study, the problem solving targets, environmental arrangement coupled with mother-child interactions and following the child's lead, were considered important aspects of the early intervention model. Though the control group also showed significant gain with the general cognitive stimulation, the gain made by infants in the experimental group was higher which indicates the effectiveness of the early intervention model. According to Shari and Siegler (14), "It is not that social phenomena are being investigated that is new in the study of children's problem solving. What is new is the increasingly widespread realisation of how deeply the social world is implicated in the development of problem solving, a broadened vision of what the development of problem solving entails, and a growing commitment to explicating the mechanisms through which cognitive and social processes jointly contribute to children's developing ability to solve problems". In the present study, the emphasis is on psycho-ecological instructional strategy which focused on tri-directional reciprocity which requires the influence of mother on child, child on mother and the influence of environment on both. The dyadic system comprising the mother and child exerts a powerful influence in fostering the child's cognitive development. The conceptualisation and development of early intervention models and approaches provide a growing body of evidence, that the goal of early intervention should be to make interactions more enjoyable and more successful (15). Freund (16) investigated the mother-child interaction on the child's ability of problem solving among 60 children from three to five years of age. The results suggested that the mothers displayed more task responsibility and regulation with younger children and the performance of children was found to be related to: the variation in maternal regulation of the child and degree of specificity of maternal verbal content. In longitudinal studies (4), mothers who were more responsive and growth promoting in their interactive behaviours, had children who showed greater growth in mental age, social and communication skills of three groups of children representing Down Syndrome, developmental disabilities and developmental delays.

CONCLUSION

Based on the findings of the study, it can be concluded that:

- The “Early intervention Model” proved to be efficacious in promoting cognitive outcomes in children with developmental delays. This is clearly evident from the pre to post treatment differences, on mental age, mental development index and mediated learning index in the experimental group.
- The differences between the experimental and control groups were highly significant, indicating the efficacy of the intervention.
- The emphasis on the psycho-ecological intervention strategy helped to promote performance outcomes in children with developmental delays.
- Training the mothers on interactive behaviors helped to improve performance outcome of children in experimental group. The control group made lower intervention gains as seen from all performance outcome measures.

Application in the community

The early intervention model finds application in the community as the emphasis is on psycho-ecological intervention strategy, which helped to improve the performance of children with developmental delays. Therefore, awareness may be created on task analysis of problem solving targets, use of specific interactions, task related materials, to mothers of children with developmental delays. The training programme designed as per the instructional systems design is an innovative approach, that makes it more feasible and applicable for use in the rural and urban setting. The mothers can be trained to carry on the programme in the house. As part of this early intervention training, the model can also be included along with physiotherapy, occupational therapy, and speech therapy for improving the cognitive outcomes in children with developmental delays, in the community.

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**AN EDUCATOR'S MANUAL FOR COMMUNITY BASED REHABILITATION:
COMMUNITY DEVELOPMENT AND THE INTEGRATION
OF PEOPLE WITH DISABILITIES**

While CBR has always focussed on the rights of people with disabilities, it can also benefit from community development strategies that address the human rights and participation of all citizens in the community. A new training approach is needed to support this community development strategy.

This manual provides discussions of key concepts, such as disability models and impact, community-based rehabilitation as a community development approach to disability, participatory adult education in community settings, effective workshop planning and evaluation. It presents suggested activities for participatory learning in much-needed areas of community sensitization to disability, disability attitude change, working with people with disabilities and proper communication. It also includes techniques for community needs assessment, resource mobilization, and action plan development. The final part of the manual provides practical information for CBR managers in establishing a community development or CBR program, forming a management committee, managing personnel and budgets, and promoting sustainability through networking, evaluation, report writing, and dissemination.

The training model and materials were developed, modified and tested in El Salvador, Nicaragua, and Honduras and are currently available in English and Spanish. Throughout the manual, the importance of effective communication with people with disabilities and their active inclusion in all phases of disability programs and initiatives are emphasized.

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The manual is available at:
https://qshare.queensu.ca/xythoswfs/webui/xy-1724450_1-t_cpTOil52