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LEARNING TO READ VIA MUSICAL INNOVATIVE TOOL INTEGRATED COMPUTER PROGRAM INFLUENCES LEARNING AND READING READINESS AND CLOSING GAPS TOWARDS SCHOOLING

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Abstract

T.M.N. (Toy Musical Notes) is an innovative musical method involving reading and playing music with a computer program, to develop reading and musical readiness. The explicitly taught reading specific language components are inadequate. T.M.N. completes the general components that implicitly underlie alphabetical languages.

The 108 pre-school children in the experiment group studied T.M.N. while the 25 in the control group studied a non-musical program. The experiment group built "first reading" schemata through explicit general reading components using the T.M.N. notation system: memory aids, a few easily identified signs, logical hierarchies, computer-games, promoting creativity through developing reading skills.

The experiment group had significantly higher results in musical and text reading abilities than the control group. The weaker half of the experimental group advanced significantly more in reading and musical abilities than the stronger half. The gap between the halves has been closed within eight months, and the benefits of learning music prior to text reading became evident.

Keywords: learning and reading readiness, early childhood, Music influence on cognition, first/second reading, general and specific reading components, easy innovative notation system, Computer Education-ware

Introduction

Contemporary educational research recognizes that numerous children face difficulties when moving from oral language to arbitrary written symbols. Researchers agree that first time learning to read is the most difficult task and any subsequent reading is easier (Rayner & Pollatsek, 1994).

Over recent decades, three recent instructional approaches for reading have been:

a) the analytic – holistic approach where words are grasped as pictures (icons) top-down, from brain to script; b) the synthetic-phonetic approach where reading is acquired bottom-up from decoding script to the brain; c) the eclectic approach integrating both, according to the child's needs (Wohl, 1998). However, UNICEF tests findings (Chiu & McBride-Chang, 2006) still show low reading achievements worldwide.

Each approach deals explicitly with the specifics of each language – phonemes - letters, spelling and syntax - which need to be relearned for each new type of reading. Though indispensable, they are insufficient to enable actual reading.

The impediments

To a large extent, comprehension relies on intonation and prosody (duration) of audible language. These 'musical' components of language are imperative for understanding meaning *in written language*. Besides mastering decoding, the young reader needs to complete the lack of full sound from his/her inner audible memory in order to assist understanding.

Another impediment is that although all conventional reading teach the *consonants, vowels, spelling and syntax explicitly*, children must acquire other essential general basics such as: expanding *audible memory*; internalizing the *alphabetical principle* of symbol-sound; *directivity*; *succession*; *fluency*; *integrating audio-visual* capacities; *analyzing* the audio-visual *structure* according to repeated–new–similar; *accumulating symbols in memory* until meaning is achieved, etc. These are taught only im*plicitly* because they are abstract rules while children's grasp is still in a concrete phase. Working on the specifics, teachers have no time to focus on the general components, which they teach only implicitly in crowded classes.

Nevertheless it is precisely these general reading components common to all alphabetical languages that create the first *reading scheme* in the child's mind.

Implications of a new approach

A literacy review of earlier studies also reveals a focus on the specific reading components (Carmon, Y., 2005; Carmon, Wohl & Even-Zohar, 2008) by dealing with transparent scripts before opaque standards and representing one-one graphemes to phonemes. Previous innovations such as the Rebus script, and Reiter's color-assisted script (1999), have all disappeared, often leaving behind fixations on incorrect spelling. However, they paved the way for another domain with both audible and written language, without any room for spelling errors - **music**.

A theory that involves music goes hand in hand with Gardner's (1979; 1997; 1996) ideas of *multiple intelligences* and the mutual impact of *close domains*, as well as with Vygotsky's Zone of Proximal Development (ZPD) (1962, 1978). It stimulated an "extra-domain" perspective to construct an innovative interdisciplinary solution for first reading acquisition and comprehension. It encouraged the establishment of patterns of gradual development in pre-school children's writing progress (Levin, 2002; 2000), where the order of development is fixed, but the rate varies from child to child. Levin's discovery of development stages in writing confirms the fixed gradual order in a child's development towards reading, and aids in diagnosing the stages (Glenn, Cousins, & Helps, 2005). These ideas inspired the development of the Toy/Tender Musical Notes method (T.M.N. tool, copyright © Carmon & "Read and Play" Ltd) in which the specific music language symbols are few and permit explicit focused teaching of the general basic components common to all alphabetical languages. This is performed concretely in the innovative method enhancing t*owards a comprehensive solution*

TMN contribution to reading

TMN confronts the two impediments mentioned earlier. Firstly, music is an excellent way to expand audible memory for comprehension (Rauscher, 1997; Rauscher, Shaw, Levine, Wright, Dennis, & Newcomb, 1997) thus enabling the internal completion of intonation and prosody that are lacking in script. Secondly, the T.M.N. method with its few easy symbols allows more attention to be paid to the general basic elements. The ability to perform concrete activities by reading/playing also enables explicitly teaching young children the general elements, using multiple-senses for easy creation of a reading scheme in the child's brain.

TMN Method

The TMN method used in this study with the *explicit* instruction of the general basic principles common to alphabetical languages consists of a first time easy musical *script.* The program integrates a computer program entitled *The House of Sounds* with games (approved by the Israeli Ministry of Education). The few easily-remembered T.M.N. symbols together with *concrete* musical keyboard playing, clarify the general reading components concretely on the keyboard.

The first time a child learns to read with the T.M.N. method is both a) a precursor to musical education, expanding hearing memory span and developing sound differentiation and b) creates a mental reading scheme that is used for both verbal text and developing learning abilities. Thus text reading at school becomes a "second" reading much easier than the first (Rayner & Pollatsek, 1994; and others).

The T.M.N. method idea concurs with many studies that point out the influence of music on cognitive processes and reading. But all other methods besides T.M.N. rely on hearing music without reading because conventional music notation is too complicated for young children (Shafer, 1981; and many others, see MNMA site – Music Notation Modern Association).

The T.M.N. method is specifically designed for early childhood. Its limited number of symbols has all the benefits of music together with a logical, hierarchically organized structure that assists memory (mnemo-technique). Eight simple symbols represent the whole musical language in logical combinations: three (O l X) for 12 pitches, three for durations (· - <), one for octaves (') and one for a pause (*) followed by duration signs as after pitch signs (for more details see Carmon, 2002). Besides developing audio-visual-motor memory, the T.M.N. symbols help to develop structure conception (Bentin, 1992; Hammer, R., Bentin, S., & Kahan, S. 1992; Platel, H., Price, C., Baron, J. C., Wise, R., Lambert, J., Frackowiak, R. S., Lechevalier, B., & Eustache, F.1997; Cash, A. H., Mallakh, R. S., Chamberlain, K, 1997). The structure conception enables analyzing the *same-varied-similar* as base of thinking developing. The focus in the current study is on developing *reading abilities* via musical abilities, and enhancing *readability* of young children and finding the population that benefits *most* from the program.

Underlying assumptions:

* There will be differences between children who learned T.M.N. in pre-school and a group who did not. Children who studied T.M.N. will have higher reading scores than children who did not.

* Differences in musical abilities will be found between the children from the T.M.N. pre-school group and the control group in distinction of: pitches, tunes and rhythms. Children who learned the TMN method will have higher achievements in Emergent Literacy tests than those who did not.

* At the end of the year, In the experimental: group: The low achieving children at the beginning of the year will have advanced more at the end of the year than the high achievers. The gaps between low and high achievers will reduce in the same measured tests.

Method

Participants

The experiment group included 108 children from six preschools who participated in the T.M.N. program weekly, and a ccontrol group of 25 children from two other preschools. Pre-intervention statistical tests showed no differences among the six experiement group preschools, or between them and the two control preschool groups.

Research tools

Four tests were delivered at the beginning and six at the end of the year, the latter two requiring greater maturity.

* Draw-a-man test (Goodenough in Harris, 1963) points to the intelligence level and formal learning readability.

* Letter flashing (McBride-Chang C., 1999): Beginning with the child's name letters and continuing in random mode to cover all letters. This test indicates accountable knowledge. Calculating the sum of known letters out of the whole gives the percent of known letters, a specific rather than a general component.

* Conceptualization of script (Hebrew version of Clay "Sand", 1977; translated by Tuval & Zeiler, 1996).

* Bentley's musical abilities test (1964-1971), Sharvit version (1992) for distinction between pairs of pitches, tunes and rhythms.

* Phonological awareness (Tubul, Lapidot, Wohl, 1995).

* Rey Test processed by Vakil (Rey in Vakil & Blachstein, 1993) for aural learning curve and status of audible memory development.

The intervention process

The musical intervention took place 45 minutes weekly in twelve groups of nine children. Every group had additional lessons with a computer once a month. A laptop computer with the *House of Sounds* program (Carmon, A., 2005) was integrated in the T.M.N. curriculum. The control group learned two programs alternating twice-a-month: drama (developing individual expression) and pet caring (developing emotional involvement in learning, in two groups of twelve children, in 90-minute sessions. All preschoolers also had music-rhythmical lesson once a week and the usual Emergent Literacy standard learning.

Results

A Pearson correlation analysis found eight significant correlations at the end of the intervention program, three of which are connected with text reading. Significant correlations were found: between melody and pitch and between rhythm and melody.

Three significant correlations were found between text reading components and musical elements.

Post-intervention testing revealed significant correlations between pitch and melody and between pitch and rhythm ($r = .232$, $p = .02$) in the experiment group only ($N=105$). No significant correlations were found between rhythm and melody. There was also significant correlation in the experiment group between the marks of Rey 5 and phonological awareness ($r = .223$, $p = .02$).

Table 1: Pearson correlation between measures at the end of the pre-school year
N=108

Pearson correlation on the variables	Draw a man 2	Phonolog-ical awar-eness	Rhythm discrimi nation2	Melody discriminat ion 2	Pitch discrim-ination 2	Letter flashing 2	Print concept-ualization 2
Print conceptualization	**.250****	**.408****	**.332****	.073	.141	**.186***	1
Letter flashing	.028	**.277****	.097	-.062	-.014	1	**.186***
Pitch discrimination 2	-.093	.080	**.291****	**.301****	1	. -014	.141
Sig. (2-tailed)	.291	.367	.001	.000		.875	.110
Melody discrimination 2	.099	.030	-.038	1	**.301****	. -062	.073
Sig. (2-tailed)	.264	.736	.664		.000	.485	.412
Rhythm discrimination 2	.053	**.201***	1	-.038	**.291****	.097	**.332****
Sig. (2-tailed)	.550	.022		.664	.001	.272	.000
Phonological awareness	**.220***	1	**.201***	.030	.080	**.277****	**.408****
Sig. (2-tailed)	.012		.022	.736	.367	.001	.000
Draw a man 2	1	**.220***	.053	.099	-.093	.028	**.250****
Sig. (2-tailed)		.012	.550	.264	.291	.752	.004

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* The correlation significance is 0.05 two tailed ** The correlation significance is 0.01 two tailed

Analysis of the assumptions

Post-intervention T-test results show significant differences between the groups in five out of the seven variables examined. Two differences are text-related variables.

In the *letter flashing* test which is connected to specific Hebrew reading components and not to the general components, the experiment group scored slightly higher than the control group. In the *Draw-a-man* test the experiment group also scored slightly higher than the control group but not significantly. At the end of the year, the experiment group showed higher achievements with regard to all variables.

An analysis T-tests process found significant differences between experiment and control groups in research variables at the end of pre-school year after the intervention: in pitch (p=.001); melody (p=.005); and rhythm (p=.001) and in print conceptualization (p=.001).

Table 2: Differences between experiment and control groups in research variables

at the end of pre-school year – T-tests

measure	The group	n	M	SD	t	p
Pitch	Experiment	105	6.44	2.55	4.277	.001
	Control	25	4.16	1.54		
Melody	Experiment	105	1.406	2.24	2.853	.005
	Control	25	990.	1.36		
Rhythm	Experiment	105	1.209	2.90	3.609	.001
	Control	25	1.17	1.88		
Phonological awareness	Experiment	105	33.53	5.11	3.578	.001
	Control	25	29.28	6.27		
Print conceptualization	Experiment	105	38.27	4.12	4.824	.001
	Control	25	32.98	7.48		
Letter flashing	Experiment	105	17.74	5.00	0.50	NS
	Control	25	17.80	5.64		
Draw a man	Experiment	108	2.97	.45	1.42	NS
	Control	25	2.82	.61		

In order to test the intervention impact on low and high achievers in the experiment group only, the subjects were divided into two groups: lower and higher than the median in all the pre-intervention measures. Repeated measures analyses were conducted and found interactions between the two groups and the pre-post tests that indicate that the low achievers gained more than the high achievers.

The findings are given below.

In *pitch*, the low group enhanced from M=3.00 to M= 5.41 (difference M=2.41) while the high group enhanced from M=5.52 to 7.00 (difference M=1.48).

Table 3: Repeated measures analysis between pre-post intervention program on *Pitch* in experiment group divided to higher and lower than median

time / level	n	Pre-intervention		Post-intervention		Total	
		M	*(SD)*	*M*	*(SD)*	*M*	(SD)
Low	34	3.00	(1.10)	5.41	(2.28)	4.21	(1.32)
High	33	5.52	5.64	7.00	(2.88)	5.58	(1.33)
Total	67	4.30	(1.61)	5.46	(2.58)	4.89	(1.33)

In *melody*, the low group enhanced from M=0.70 to M=2.34 (difference M=1.64) while the high group enhanced from M= 0.72 to1.59 (different of only M=0.87) at the end of year.

Table 4: Repeated measures analysis between pre-post intervention program on *Melody* in experiment group divided to higher and lower than median

Time / Group level	n	Pre intervention		Post intervention		Total	
		M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Low	50	0.70	(.46)	2.34	(1.65)	1.52	(.82)
high	17	(0.72)	2.53	1.59	(1.23)	2.06	(.82)
Total	67	(0.96)	1.16	2.15	(1.58)	1.65	(.94)

In rhythm low group enhanced from M=.72 to 2.88 (difference M=2.16), while the high group enhanced from M=2.62 to3.00 (difference M=0.38).

Table 5: Repeated measures analysis between pre-post intervention program on *Rhythm* in experiment group divided to higher and lower than median

Time / Group	n	Pre intervention *M* *(SD)*		Post-intervention *M (SD)*		Total *M (SD)*	
Low	25	.72	(.46)	2.88	(1.42)	1.80	(.84)
High	42	2.62	(.82)	3.00	(1.36)	2.81	(.84)
Total	67	1.16	(1. 61)	2.96	(1.37)	2.06	(.87)

In *print conceptualization* the low group enhanced from M=26.73 to M=38.73, (difference M=11.64) while the high group enhanced from M= 35.28 to M=39.50 (difference M=4.22).The low group ended with M=0.77 difference, almost closing gap (from M=11.64 to M= 0.77).

Table No. 6: Repeated measures analysis between pre-post intervention program on

Print conceptualization in experiment group divided to higher and lower than median

Rhythm / Group	n	Pre intervention		Post intervention		Total	
		M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Low	35	26.73	(3.69)	38.25	(4.37)	32.49	(3.98)
High	34	35.28	(2.81)	39.50	(3.60)	37.39	(3.21)
Total	69	30.94	(5.40)	38.86	(4.03)	34.94	(3.06)

There are significant differences for pre and post intervention program between the low and high groups in *Draw-a-man* achievements. Again the improvement of the low group was greater than that of the higher group.(low advanced from M=2.28 to M=2.79 (M=+0.55) while the high group declined from M=3.19 to M=3.06 (M= - 0.13).

For letter flashing, achievements doubled in the low group (from M=7.70 to 15.49,) but scarcely changed in the higher group from 18.39 to 19.47).

Rey -Aural Learning Curve Test, delivered only at the end of the year, showed significant memory of heard words difference between the experience group that improved M=1.8 words double than the control group that improved M= 0.9 words.

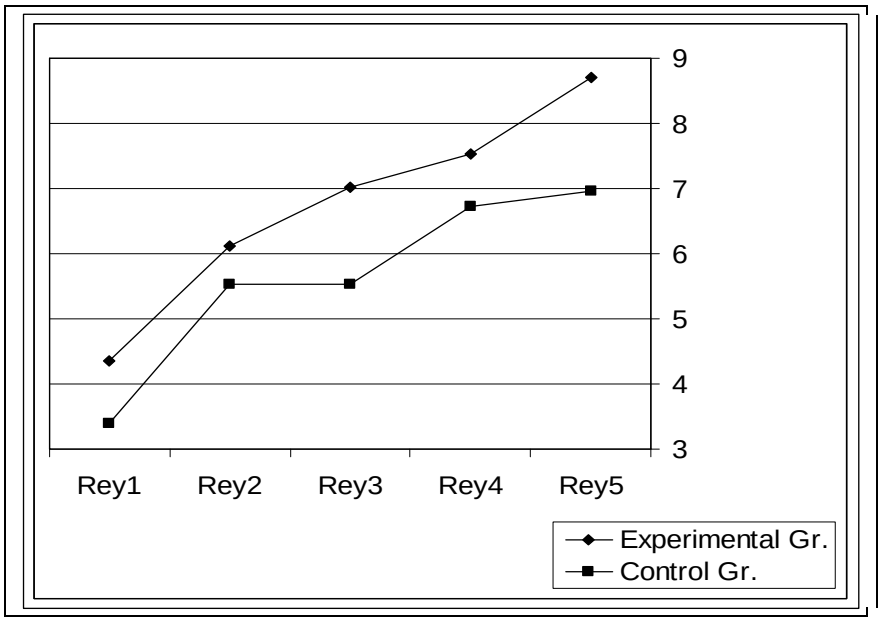

Figure 1: Rey test - Aural Learning Curve at the **end** of Pre-school year

Means of aurally remembered words five times sequentially

Discussion

In general, the total difference pre- and post- between the experiment and control groups shows that the intervention was generally successful. The intervention program impacted musical achievements and text reading readiness and learning abilities at the same time.

At the end of the intervention program, significant correlations were found: three between components connected to text reading (print conceptualization, letter flashing and phonological awareness) and two between verbal and musical components indicating salient connections between them, even though they do not belong to the same domain: between rhythm - and print conceptualization and phonological awareness. These findings support studies which indicate that intonation and prosody assist reading comprehension (Adams & Bruck, 1993), but in order to understand the reason and process, additional research is needed. These connections between reading and musical components strengthen the idea described in the introduction, that music learning at an early stage contributes to the acquisition of the skill of reading.

Correlations were also found between *Draw-a-man* that indicates maturity for formal learning and print conceptualization and phonological awareness, but not between *Draw-a-man* and musical components. This shows that music is not dependent on formal learning maturity, which means that it may be acquired *before* a child is mature enough for learning, whereas learning to read indeed requires a certain maturity.

Pre / post differences between experiment and control groups:

All the research measures revealed significant differences between the experiment and control groups at the end of the intervention program, except for letter flashing, and for *Draw-a-man* (both higher but statistically insignificant). In the case of the latter, this might be because; a latency period is needed for mental processing in this field (Carmon, 2002; Carmon & Elkoshi, 2008).

The interaction between the general learning components achieved by the TMN learning on hearing memory span and comprehension shows that the learning rate in the experiment group was quicker and higher than in the control group.

Experiment group's high-low achiever differences

For most of the dependent variables the lower than median examinees improved significantly at the end of the year, while for the higher than median examinees there were no differences and in some cases there was even a slight decline. Thus, the conclusion is that the intervention indeed assists the development of reading abilities before school.

The program enabled the lower achievers to enter school with their full potential.

The Rey test was measured five times sequentially at the end of year with significant differences between experiment and control groups in the first, third and fifth hearing. The musical intervention in the experiment group compared to the control group showed hearing memory development that influences verbal hearing (Koren, 1993) though lack of maturity prevented this from being tested at the beginning of the year.

The natural conclusion is: once a child develops a musical ear this impacts any auditory experience whether verbal or musical. This was found also in another study (Carmon, 2002) when high positive correlation (r=.70) was found between Phonological awareness and musical distinction abilities (Bentley), and encouraged Koren study (1993).

The results of the phonological awareness tests, also conducted only at the end of the year, showed that the experiment group's achievements were higher than those of the control group by an average of 4.7 points; p=.001.

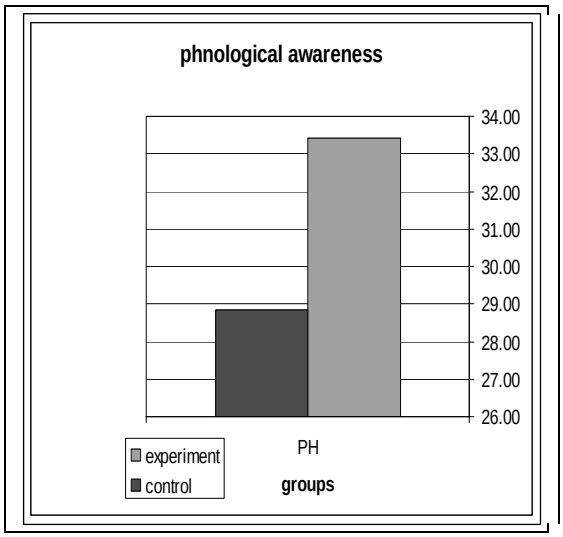

Figure 2: Phonological awareness in experiment group

Compared to control group at the end of pre-school year

It seems that the musical intervention impact is noticeable also in the verbal component of phonological awareness because the musical intervention is the main reason for the difference between the groups. This confirms Vygotzky's findings (1978) on the influence of proximal domains, such as in this case of musical and verbal language, when the common general components have been taken care of in the intervention program and have influenced the verbal language.

From all the above it is clear that the main hypothesis of a connection between music and verbal language is confirmed. Learning one language (T.M.N. in this case) contributes to and enhances the mental processing of another language. The learning of TMN reading creates a first reading scheme which is used by the child when he/she comes to further reading.

These research results show that the children who benefited most from the T.M.N. learning were those who had lower achievements at the start. These children advanced faster in processing the general reading components and the gap between them and the higher achievers closed.

Conclusion

The operative conclusion from this study is that when preparing children for school, it is worthwhile including the T.M.N. learning computer integrated program.

The theoretical contribution of separating general reading components, their explicit teaching with very few specific reading components, while experiencing concrete reading, makes it possible to use the common components acquired in T.M.N. when moving to text reading, easily. In this way the theory supports music as a tool to enhance readiness for schooling.

Promotion of reading and learning through T.M.N. will advance humanity with an international base language that will lead to the inclusion of cultures and contribute to humanity also via music, to enhance science that is based on reading and advance musical art level of human beings in a smarter and nicer sounding world.

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More articles about T.M.N. can be seen connected to the site: www.readandplay.co.il

To find short film of activating T.M.N. see: http://www.youtube.com/watch?v=7etJiy7BA0Q