Stories For Teaching Systems Thinking:

Development and Implementation Guide

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Abstract

Stories have shown to be very beneficial in teaching complex concepts to children, including system thinking. However, few stories for teaching systems thinking have been developed; indeed it seems that there exists a gap between writers and system practitioners, as writers don't know how to develop stories containing systems thinking concepts. Hence, Asemaan's[1] experience of writing and teaching systems thinking stories to k-12 students is presented in a structured and integrated framework as a guide for writing and telling these stories. Also, the study proposes some ideas around deficiencies of current written and oral language structures of conveying systems thinking concepts and quality of tasks conducted in the class while telling stories.

Keywords: Systems Thinking, Story Development, Story Telling

[1]Asemaan is the center for system thinking studies in Sharif University of Technology, Tehran, Iran.

Introduction

We live in an age of interdependence, but most of individuals' policies, decisions and mindsets come from a more primitive paradigm of linear thinking. The critical challenges faced by the world today are obstinately resistant to solutions. It's time for a shift (Global Systems Initiatives 2012). Future generations will be called to solve some of the most challenging problems ever created and faced by man; Our children must master methods to envision multiple approaches for addressing complex challenges like renewable energy, world hunger, climate change, and ultimately, the design of a better world; then what is the duty of today's generation?

To respond and fulfill the concerns addressed, "Asemaan Group", devoting itself to the idea of educating capable future generation, commenced extensive studies to devise programs to build up required thinking skills in mentioned target group; as a result of these studies systems thinking skills were found as the appropriate response for needs of the society, since the final goal of teaching systems thinking is preparing an effective way for thinking about systems complexities (Forrester 1992). Systems thinking skills as a helping tool for individuals' and socials' planning has more effectiveness if it is created in early ages.

In traditional approach, teachers stand in front of students and transfer information about various subject and students are completely inactive, but since teaching systems thinking the same way, analogous to what is performed in universities doesn't represent satisfying outcome in early ages, new methods of teaching should have been formulated for this group.

The logic behind the case is very simple; stories are of the first means with which kids match their thoughts to the world outside and they are of the most primary teachers of children; similarly games provide the environment that children for the first time evaluate their skills and also learn how to think and act through repetition of them. These tools used to deliver the basic thinking structure to children when still the cognitive processes of those children were so naïve; why not systems thinking practitioners use the same way to convey their intended content to school children?

To do so however, there exist some serious obstacles. First and foremost, they are a few stories designed for teaching systems thinking to those in early ages like elementary school students or even k-12. Asemaan Group through its five year experience has tried and tested several categories of stories and methods to teach systems thinking skills to children. What will be included in the proceeding lines are the results of these experiences in a set of recommendation about how to develop stories involving systems thinking concepts, which could be thought in the class and also several guidelines about their representation.at last the methodology which we have based our comparative selection to derive this framework of reference is demonstrated.

STORY DEVELOPMENT STRATEGIES

To construct stories with systems thinking themes, one can indeed reengineer the existing stories. In Asemaan, at first we tried to use translated formats of stories developed by centers such as waters foundation or MIT, but through our years of teaching experience we came to understand that students in the classrooms do not communicate with the concepts buried in the story plots. What we were suggesting was too big of a change, leaving behind children and their abilities. This problem was even worse using stories with inferior depiction of intended concepts, and translations which were not successful in transmitting ideas- mostly due to coverage of strong cultural elements in the main text; therefore alienating the students from our practice in the class.

With these reported on our evaluative tests, we took action to resolve the issue; after challenging discussions in Asemaan's main board and consulting with education and systems thinking specialists based on evaluation tests' results, it was told that Asemaan needed stories with simple and appealing settings and plots for children, containing rigorous systems thinking concepts. For reaching these targets three strategy was formulated:

1-Extension based on closing the loops in traditional stories:

First strategy line was to considering traditional stories, namely folktales; these stories were in essence simple and also attractive, which were the main reasons in the first place to their survival over years. These stories usually represented some kind of linear causation, yet deprived of any systematic thinking paradigm; the main challenge in utilizing these stories as a systems thinking educational tool was to shift one-way causalities to circular feedback ones. To summarize, all the effort should have been focused on completing feedback loops in the stories with devising new scenarios in the stories.

To compose these scenarios the writers would better follow these tasks:

1-1: Identify the main variables

Approach the story as you want to build a system dynamics model of the case. Analyze plot and characters of the story, together with considering its theme. Recognize main variables of the story which are having critical role in developing the story flow and are changing through organization of events. Using problem articulation techniques reflected in system dynamics modeling tutorials is quiet valuable here.

For example consider you have a story about an arrogant king determined to increase his wealth by increasing the tax rate. A typical traditional story will mainly revolve around the cruelty of tax agents and the poverty of people and their miseries, and if we get lucky it will conclude in some kind of social upraise which could even topple the king; in this story the reaction of people in form of rate of dissatisfaction, stock of tax revenue, poverty of citizens

and even the arrogances of the king could be considered as main variable which could be taken in to next steps.

1-2: Explore Possible Dynamics of the variable

Again, analogues to system dynamics modeling in this section one should explore the trend and dynamic behavior of selected variables and moreover think of creating scenarios which could extrapolate the existing dynamic, think of it as hope and fear scenario making of reference mode in system dynamic modeling.

As I mentioned these scenarios are ought not to produce similar outcomes with the main story's results and may even be opposite; since you are the one who is going to extend the story based on one of them; what really matters here is that the scenario bolds the dynamic as explicit as possible, this could be done by emphasizing a change in dynamic behavior; Selecting between these scenarios depends on what comes in next steps.

To elaborate more, again consider the previous example, in this case you could extrapolate the tax behavior in very different ways: the king uses the tax money to improve security status so the tax payments increase, or high rate of taxes causes the citizens to flee the country leaving the king devastated, or the king redistributes tax income in a way that overall welfare of the society increases and the tax income increases without increasing the tax rates anymore.

1-3: Choose the concept most compatible with children's experience:

Through our years of experience in early age education, we come to understand that there is this great desire in students to know about realities and how they work; students resisted the ideas of the adult world but at the same time yearned to find their place inside it, and any story or plot that was able to meet and satisfy this thirst was utterly successful in conveying educational content. Therefore it is recommended to choose those scenarios, related to most current problems which students hear on dinner tables, other classes, TV or even experiencing them on the streets. The more the student is informed of the urgency of issue the more is its impact.

1-4: Add up systems thinking skills

Once you have decided about which scenario to pick, think about the ways you could elaborate the scenario in order to bringing more of systems thinking skills (Richmond 1993) into action. These elaborations should be orientated in such a ways that model and explain the real world problem more efficiently.

You may have notices that this step is in very close relationship with the previous one, indeed skilled choose here could deeply effect how the reality outside is modeled in the story and simultaneously choosing of a specific scenario could limit our ability in adding systems

thinking skills. Hence it's favorable for authors to have an eye on this step, while deciding about step three. For example recall our tax example, this case explicitly takes dynamic thinking into account but you could always stimulate generic thinking or holistic thinking by highlighting many factors that are contributing to the subject; you can convey the principles of scientific and operational thinking by exactly elaborating the mechanisms of events and explaining about how and why of interactions; namely how an higher tax rate on rich could lead to unemployment of the poor and overall decrease in tax income .

1-5: Maximize efficiency

Always carry this assumption that our goal is to convey wider and deeper systems thinking and system dynamics concepts with an even simpler plot and setting in each story; always ask yourself if you can add anything more- from archetype structures, mental models or delay concepts to depicting stock and flow variables- for students, And how you could accommodate these new concepts in a simpler and more attracting concept.

1-6: Coherency check

The last step is to make sure that all the steps above have been organized in a coherent framework retaining the main theme of the story; remember that all we trying to achieve in this strategy is to instruct systems thinking concepts with rooting ourselves deep into cultural bonds of individuals and even improving them.

By doing so another major contribution is to teach maxims and codes in these stories more effectively, instead of just giving vague, boring advices about being good; indeed, with the tool we have developed by representing the dynamic and interactions, we can tell why one should do good and respect maxims.

Finally, make sure whether the stated structures lead to assigned dynamic, and be careful about what result your logics can guide children in action, especially by applying them into other possible experiences; try to avoid any troubling issue especially ideological and religious beliefs.

2-Extension based on Problem Solving

Second strategy was formulated as a method based on proposing one complex problem in the story, and accompanying the readers through full systematic problem solving practice, along which the writer would try to contain systems thinking skills and concepts.

A critical point about this approach is that one should choose those issues and complexities which are motivating for students or are of their everyday life experience and dealt obstacles, since this concept increases the leverage of the whole story telling and learning process. Another important subject is that the writer should emphasize on the mechanism of systematic problem

solving and our language should not foster an event based viewpoint in reader, indeed the writer should introduce her tools and structure of logic used for achieving such solutions.

To clarify, the differences between this strategy and the previous one is that in the first strategy, theme and setting of the story remains intact and the writer merely modifies the story to complete and close the feedback loops. But in this strategy the writer might only take a small idea from the story and then create a whole new theme for supporting the solution generation mechanism of the problem intended in the idea. Using this strategy you may turn a two page short story into a ten pages of problem solving practice in a story form!

To elaborate more, the authors propose below steps to be followed by the story writers:

2-1: Highlight the Difficulty and Define the Problem

Most of traditional and also modern stories for the kids chronicle series of events-usually obstacles- happening for the main character and her endeavors to solve them; what these stories propose for solution is often mixture of magical and supernatural aids from outside or superpowers of the main character herself, which lead to oversimplified happy endings; more often their goal is to convey some kind of moral quality. For example, to devalue the practice of lying the writer depicts a liar character which always loses. But as we will discuss later their approach seems less efficient and this context has a great potential to be intervened by systems thinking skills.

At first, choose a story having most intriguing difficulties for the children in the plot. Then try to define the problems, which may have caused that difficulties in the real world, do not limit yourself to the setting existing in the story, since you could almost construct new modules to support your problem definition. Try to explicitly clarify what is the problem and why it is a problem in the first paragraph of the story.

2-2: Take the Reader through Search of Clues

In this section the writer should address two main questions:

- What could have caused the problem?
- How the problem is being generated?

For responding these two questions the writer should study and propose some key variables of the problem together with their time trends in order to show how the problem has evolved over time. For this purpose the writer may design scenarios of traveling, detection or etc., to familiarize the students with the art of constructing hypothetical scenarios to explain their problems and then teaching them the need to their validation and accreditation.

For example in a story of a king ruling a country facing various impediments you could introduce two loyal agents or even ministers which have the authority and objective of

identifying main variable and constructing the dynamic hypothesis through adventurous trips to different districts of the country or undergoing secret operations to obtain information.

2-3: Demonstrate the Structure of the Problem

One important task of the writer in these kind of stories is to demonstrate that each problem which has been persistent over a period of time is being driven by some kind of strong structure and that this structure is not limited to unique event and can simply emerge in others too. Overall the writer's duty is to manifest this structure as the output of all previous steps and this should be done by closely relating generated story components in a way that the structure forms as an integrated whole in students' mind. Techniques for such a practice will be given in proceeding sections.

2-4: Validate the Claims

Don't forget to spare some lines to write a scenario which includes validation of your claims in previous sections; this is very important in the sense of conveying and emphasizing scientific thinking; and demonstrating that variables stated in the story and their quantification are significant; also in this way an skilled writer could even get a glimpse on operational thinking skill; as she defines that the constructed theory works, she can exactly address how it works.

Namely, in the context of our story this can be depicted by a scenario, in which the king thinks of an unexpected observation of the troubled organization, to see whether those allegations of his agents are true or not.

2-5: Design a Policy

This part is optional since what you will propose here would be a review of the skills stated in the previous sections; yet it's embedding completely a higher cognitive level than any of previous sections as it tends to create something. The writer should be careful how to convey mechanism of policy making and its framework emphasizing concepts such as policy resistance. Indeed, this part can be designed in a form of an assignment in order to engage the students more actively in the process of thinking systemically and acting dynamically. In addition, this could match the story contents and ideas, to students' real world experience-by proposing the mechanism for solving them- which encourages learning and stimulates motivations.

3-Creating Stories from Scratch

The third strategy comes to represent a completely different approach in Asemaan's story development history, which is better to be fully explained in an independent paper, and only a brief mention is being made in this paper and the rest will be addressed to our future works.

The core idea in this strategy is analogous to previous ones, but with a great difference, as the writer has to construct the systematic theme and plots herself –which should be attracting to

students, together with discussing most up-to-date world class issues. This strategy's main target group is those children who are mostly interested in new fashionable video games and movies and may not found those traditional stories, very appealing.

Organizing the Content into the Body of Story

Having a roadmap as represented above would help a lot to design the plotline of the story; but still organizing these content into an appealing and homogenous structure, which would not distract or overshadow the main message and also serves as a facilitator of learning interactions is a challenging task; through Asemaan's experience we characterized the task to be of intricate nature as it mainly depended on the writer's ability of scenario planning and elaboration. Although the task was observed to be as a highly subjective one, we like to mention some patterns and ideas which were contentious and deserved deep attention:

1- Vocabulary and Sentence Structure

In years of our experience in educating system dynamics and systems thinking to students -from university to school-, managers and teachers; when we went through evaluating our performance and practice, there was always this persistent challenge that our language and medium of communication with our students was unable to fully convey and transmit the intended concepts we were striving for. Namely, consider elaborating the dynamic of an issue risen for a kid as having a low GPA in one semester; for this you may have to give an at least a five minute lecture in the class not only because you have to mention past behaviors trend patterns but also there are concepts such as" rate of change of motivation" or "rate of change of attention" which cannot simply be depicted in words and as your language becomes more complex describing these, the students merely think why to get into trouble of thinking this way, when the easy justification lies before to say it was the teacher's fault or a bad luck. Furthermore, you may have experienced how difficult it becomes to report feedback loops (and be sure it's much more difficult when trying to chronicle it in the story), because when you try to do so the structure of sentences in the language doesn't allow you to represent it other than some consecutive linear causation that are clustered together and not easily apprehended; it also could be the very reason why we mostly use visual aids to understand these feedback loops, though such a chance is not available in writing a story.

What we're trying to say is that there seems to be an inherited natural flaw in our language -Persian, to some extent English and may be other languages- that has ensued from an experience of thousands years in using static and linear thinking approaches; it is the reason why we don't have words for most of our flow variables-which make us to use phrases like "increase rate of something"- while there are several for their stocks (Mashayekhi 2012) and the reason why the writing structure does not support reporting feedback loops in an effective way.

This issue which seems to be a major one and a great obstacle hindering teaching of systems thinking, system dynamics and also writing stories, will not be explained more in this paper, as it needs intense work of linguists and system practitioners; and though the story writers will face the mentioned problems in their practice of story planning we suggest to them to use the techniques which will come in proceeding lines to alleviate the problem.

2- Positioning of Story Components

The start of the story is very important, since in most cases it is the one and only part where the children decide to give their attention to it; therefore it should be as intriguing as possible, stimulating children's motivation. Start out the story with a confronting or intriguing problem (Green 2004)or you can simply surprise them by failing the expectations they had formed about an issue.an alternative approach is to start the story the same as classic folktale especially those ones with an intense engagement in depiction of setting of the story and characterization; however, as it may be obvious, the latter one will require a more skilled writer, yet they represented much more better performance in the way the children remembered them and identified themselves with the protagonist of the story.

Throughout the story try to engage readers with high-cognitive-requiring concepts and tasks, in order to give them the chance to experience the thinking capacities of systematic problems. This could be accomplished by implicitly proposing how and why questions in the dialogues of the characters and answering them.

In addition, there are several plotlines which could be used to pursue detail in child stories; one of the most helpful of them is using binary opposites; this is a great tool in organizing and categorizing the teaching and knowledge attached to the content (Egan 2005)because it's one of most primitive organizations that any man learn due to opposition in destruction or survival; it could even assist you in acquiring a big picture of arranging your content into meaningful episodes. The second approach is associating your story with heroes; it will provide the children the confidence that them themselves can face and deal with the difficulties of the real world (Egan 2005)which systems thinking addresses. Furthermore this approach deepens the learning level by creating role models that children could personify. these heroes need not be of those muscular usual western types, an intelligent kid or even a good minister or king would do the trick; also its very helpful to include characters as teachers or some kind of old wise man, which children could revert to them in the time of problem; most of us lament the opportunity to have such a figure in our real life to consult in time of difficulty, the one who knows everything, and maybe we still have that imaginary wise in our mind; In other words by describing a mental picture of an ideal system thinker, we could expect a durable contribution to future thinkers decision making process. Also, make use of the capacities in children for revolt and idealism; in this age children desire to be part of the world of adults and at the same time they are highly rebellious to it, yearning to make it better. (Egan 2005)If you could signify these kind of themes in your story then you will be assured that it will draw the attention and participation of the

children. One last point to remember is to use experience in the stories which is extreme and to somehow is the limit of reality. In this way you are carving a picture into the mind of children which powerfully engages imaginary and also simplifies the conditions faced in most of dynamics and systematic problems which in turn can foster the learning.

Finally,the end of the story should be planned in a way that could conclude what was said in the previous sections; try to give emphasize to the most dominant structure that helped the problem to emerge or the policies that helped to solve it and where they did target.

Issues related with storytelling

As a story writer you should have thought of the ways your story is going to be delivered to the target readers, whether it'll be used by parents as night story or it'll be used in the classroom by teachers, could give you some hints about how to develop it or even giving instruction for the ones who are using it.

In this section we are providing a set of recommendations which could guide the writers how to adopt their stories to the storytelling approaches and also giving instructions to those who are using them.

1- Present Lively

In our five years' experience of storytelling, as was anticipated the most effective stories for teaching were those which their presentations included lively discussions and engagement by students. However our further studies revealed that, this liveliness was not solely dependent on the storyteller, and in many cases the story itself contributed a lot more. Hence, what the writer does about making her story efficient for storytelling turns out to be much critical.

The first point worth of mentioning in this subject is taking into account the gender psychology; kids in our target ages (10-13) represented almost contrasting behavior patterns in the class, and it cost us a lot in time and resources to fix it; this practice even caused fundamental changes in stories in some cases. The problem was that girls were too swamped in their personal issues and emotions, a very common situation regarding their puberty, unresponsive and uninterested about what was proposed in the class yet a class of boys was very engaging as students were enthusiastically participating in the subjects proposed such as discovering the ways world and society works and even were determined to change it. Therefore, it becomes very essential both for the storyteller and story writer to know and utilize the mental models of her audiences in order to motivate them to participate in the process of storytelling.(However our studies showed that the effect should be less prevailing in coed classes)

Also try to use any kind of communication that seems to be more effective, for this the writer should devise whether the story will be represented with a narrator sitting on a chair or in a theatrical form or any other; even she may engage in making visual interface for story as cards or movie to foster students 'engagement.

2- Maximize Learning

Writer and story teller should always think of ways to optimize learning procedures; though every organization based on its experiences has its own ways to conduct this issue, there are some general rules that must be taken into account as the writer plans to give instructions to story tellers. According to Katherine Merseth (February 2012)the most important subject in this case is focusing on the tasks; she argues that what are students asked to do, is the main index and process to predict their performance, also the accountability of teachings are embedded in the answers that student provide for these tasks.

These tasks could be asking children to draw the dynamic of the issue represented or it may be explaining the feedback structure observed, in their own language. These are very critical issues for the writers to think about to organize the story in a way that allows the story teller to ask question with high cognitive demand; which could be done by lowering the intensity of storie's event chain interaction-usually by concluding the paragraph- after transporting a load of systematic information. This would give the story teller the opportunity to ask about the concepts.

Also it would be better if the story teller could guide learners engagement in classroom's discussions by asking open ended questions (Merseth 2012) in a way that they'd be motivated to speculate the end of stories, this practice could help a lot in building students' ability of generating hypothetical explanations for the issues around them which is closely related to their ability of problem solving.

Experience and Research Design

This section provides the method that was used to extract the preceding propositions from our teachers and writers experiences. Data collection in this study was conducted using semi-structured interviews and analyzing class observation. Due to the qualitative nature of the research, a purposeful sampling was used (Patton 1990). The interviews continued until the saturation of information was achieved, that is, the state in which interviews with new individuals only obtained previous collected data (Seidman 2006).

1- Theoretical Framework

This section proposes that identification of stories' performance can be incorporated into the framework of the instructional core. Figure 1 demonstrates this model. The instructional core has three aspects to it; the teacher, student and content. These three work together in a triangle that is interactive and dynamic. "And truly is where the learning and the result of the hard work of the teachers and the students and those who write the curriculum comes to fruition." (Merseth 2012)

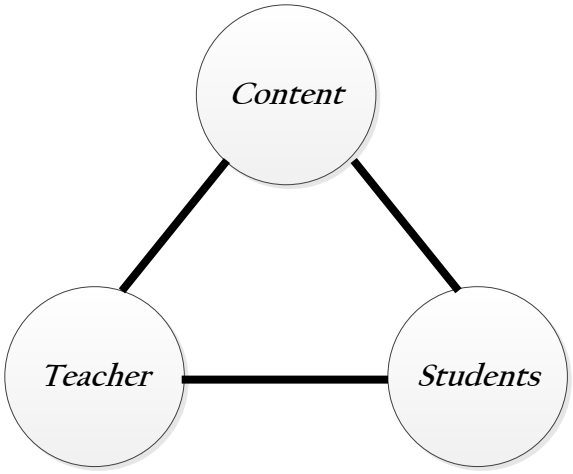

Figure 1: The instructional core.
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The instructional core has several principles. The very principal is that any positive change in students learning is a consequence of either improvement in the quality of content, what's being taught to the children, or improved skill and the knowledge of the teachers and how they do this, and finally student's participation rate.

Second principle of the instructional core is that due to high interactions of these three elements, when one of them is changed inevitable the other two should change too. And if we tweak on one side, we will then necessarily affect the other side. So if the content which the teachers are teaching is changed, they'll have to teach it differently (Merseth 2012).

2- Sample

The data collection process of this study required detailed interviews to acquire the interviewee's experience in details and depth. That is why a purposeful sampling method was employed (Seidman 2006). The interviewees selected through this sampling process were a combination of individuals in different roles and disciplines in addition to teachers, (Considering schools structure in Figure 1). Vice president and schools' managers were included because of

their responsibilities for policy-making, setting standards, and controlling the learning process in schools. This makes them the best source on curriculum standards and policies related to the learning process, since due to their roles as the highest executive managers of their schools, they were knowledgeable on the required competencies for systems thinking stories. The other group included in the interviewees as mentioned, were the 'teachers' in schools who taught the stories in their own classes and thus, were the most informed individuals about performance and roles of stories in students' learning.

Furthermore, schools' consultants were also included in the interviews because of being in charge of the whole students' mentalities (i.e. students' dealing with issues during their consultations, and responding to their problems). Besides, parents were usually among the most involved systems thinking skills in relation with their children which make them uniquely informed of qualities of stories.

A sample of students was also a part of the interviewees owing to the fact that they receive direct impact of changes in their views. Since the final goal of the systems thinking stories was to create and improve thinking skill, students were a proper source for the identification of features required for developing systems thinking stories. Finally, some best performers among students, introduced by their teachers, were included in the interviews to comment on general features of stories.

3- Interview Questions

The interviews consisted of a set of questions according to the theoretical framework in order to identify the intended three main fields of information.

In addition, some specific questions were also developed for interviewing students in order to understand their expectations about the features and attributes of a good teacher and competent environment in system thinking class.

4- Data Analysis Techniques

By analyzing interviews, key features of effective stories from both teacher's and students' viewpoints were determined and analyzed; efficient performance indicators of teachers in the class were formulated and methods for student participation were observed. Regarding to the theoretical framework, the next step was to identify the key strategies. Some of the key quotations of interviews are presented in the Appendix.

In order to analyze the collected data and develop a model, the interviews were investigated using the thematic analysis technique (Braun and Clarke 2006) and any phrase or sentence referring to the research goals was extracted and coded (Hesse and Sharlene 2004). Then, the data was classified into categories, each titled by a main theme. Some of the main categories had

their own sub-categories, named sub-theme. Identifying these sub-categories continued until all the identified concepts were addressed (Braun and Clarke 2006). (Some important quotations from the interviewees' answers, representing prevailing ideas in the sample are included in the appendix)

5- Validation

In the validation stage, the features and their important elements were checked to determine the significance of each feature in the successful performance of thinking ability in students. Various methodologies could have been used for examining the validation of results, but also there were some constrains; for example predictive validity test that assesses the extent to which a feature predicts the future performance of thinking ability in individuals, was not feasible given the time consuming nature of this methodology and considering the practical limitation of this study. Consequently, a focus group of selected knowledgeable experts of the Asemaan group was formed to investigate the significance of each feature in the story development model.

At the end, the story development model was completed by taking two factors into account; first the frequency of each feature pointed out in the interviews, and second the importance of each feature assigned in the validation meeting. Feature with a frequency or validation point less than 2 were eliminated from the list of features after making a consensus with the members of the validation meeting.

Conclusion

Teaching systems thinking, facing the challenges of the world outside becomes more urgent by every passing day; and it's a burden to be borne by the practitioners of system dynamics community.

But this shall be recognized that the concepts in this field are in essence different from what is provided for the children in early education; therefore the system dynamics community should commit itself to devise and test innovative methods compatible to its precious content.so far stories and games have proved to be an effective approach in conveying systems thinking concepts and our efforts should be focused upon providing rigorous content in this area.

In this study authors have rationed Asemaan's five years of experience in storytelling and teaching systems thinking into a frame of reference which could be used by other practitioners who are active in this field. Yet, several intricate questions was raised in this study, that the most important of all, was about language structures utilized in teaching systems thinking, which is crucial to be addressed in future researches and studies.

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Appendix

Tables

Table1. Sample Composition

Interviewees	Sample Size	Population Size
Systems Thinking teachers	3	11
Normal Teachers	2	20
Principals-Vice president	2	5
Parents	8	
Students	15	70

Table 2. Identified themes related to key issues regarding story development and telling.

ST Story Development and Telling	
1.1 Adopted Stories From Waters Foundation and MIT	
Elements	Sample quotation
1.1.1 Students' apprehension of the embedded content.	"Settings of these stories are whether bizarre or simplistic, though they are not interesting enough to engage student with their contents." A systems thinking teacher.
1.1.2 difficulties due to translation	"Name, social concepts and rituals provided in the story and its translation were new and in some cases strange, every session a good deal of time was spent to address these confusions." A system thinking teachers
1.2 Development Based on Extension	
1.2.1 Similarity with past experience of story reading	"As students study texts like these stories in their standard curriculum, they feel more affinity with them and then their participation is augmented ."; A normal teacher

1.2.2 Issues regarding implementation of the story telling program in the class	"Teachers could better implement this type of storytelling in the class because they exercise the same practice with similar texts in literature class and it's much easier to cope with the content provided."; A School principal
1.2.3 Influenced by the story ,showing empathy with characters	"…So I don't like to act as Hasanak (a character of a story) did, because I know the undesired consequences of static thinking without a holistic viewpoint." A Student.
1.3 Development Based on Problem Solving	
1.3.1 Problem Identification	"Once we were stuck in the traffic my son asked about reasons of traffic generation, I gave him several hints but he wasn't satisfied, moaning that I haven't provided the structure behind the problem ."; A Parent
1.4 Story Telling and Presentation	
1.4.1 Attributes of an effective story in the class	"Shocking the students at the start of the story is the most effective way to draw their attention to what happens in the story ."; A systems thinking teacher
1.4.2 Cognitive Tasks	"Asking How and Why question about the issues and events that occurs in the story is the main stimulus of thinking, discussion and deeper apprehension of content among the students."; A systems thinking teacher