

# Humor in Elementary Science: Development and Evaluation of Comic Strips about Sound

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## Abstract

Comic strips on newspapers, magazines and Internet are one of the most accessible materials that may be used in science classroom as instructional tool. However, it is sometimes difficult to find and adapt appropriate comic strips useful for instructional purposes, because most of them are irrelevant. The purpose of this study is to develop and evaluate instructional comic strips aiming to contribute learning about sound related concepts. In this study, a series of instructional comic strips were created and implemented to a group of seventh grade students. Students' responses to a number of open-ended questions were evaluated through qualitative content analysis. According to results, most of the students believed that comic strips help learning through simplifying science concepts and making retention of them easier. In addition, comic strips seemed to contribute students' enjoyment toward science and perception of success in science.

**Keywords:** Comic strips, Cartoon, Humor, Sound, Elementary science

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## Introduction


### *Problem*

Many people from all cultures and all ages like reading comic strips that are one of the most common media carrying humor. Because of this affection, comic strips are sometimes used for instructional purposes. In the newspapers, magazines and Internet, huge amount of comic strips are available. However, according to Cheesman (2006), very few comics in mass media are explicitly scientific. For a science teacher, it is sometimes difficult to find and adapt relevant comic strips for teaching science concepts. This study tries to develop and evaluate a number of examples of comic strips aiming to contribute learning about sound related concepts.

### *Humor*

Humor is described in literature with its various aspects. Dieter (2000) states that the most forms of humor are based on incongruity. In other words, humor is often originated from unexpected responses, which are out of social norms, to familiar events or situations.

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Therefore, if an audience is uninformed about the familiar part of humor, he/she will miss the unexpected part or punch line of it. Similarly, according to Dingfelder (2006), the enjoyment of humor often comes from seeing familiar situations with new eyes. That is to say, humor gives people new insight into a familiar situation through juxtaposition of familiar and unexpected. Correspondingly, Wanzer, Frymier, Wojtaszczyk and Smith (2006) define humor as norm violation in an appropriately perceived way. In other words, humor violates social norms without insulting values of people. Therefore, it can be said that the perception of humor is as important as intention of it.

Humor that is used in classroom may be divided into several categories. According to Wanzer et al. (2006), humor in the classroom is presented through jokes, riddles, puns, sarcasm, one-liners, nonverbal behaviors and cartoons. In a similar way, Gorham and Christophel (1990) classify classroom humor into six categories: joke, riddle, pun, funny story, humorous comment and visual/vocal comedy.

Some advantages of using humor in teaching/learning process are discussed in literature. Gorham and Christophel (1990) point out that the use of humor in the classroom increases immediacy of teacher, which decreases social distance between teacher and students. Humor also helps in reducing tension in the classroom, relieving students' embarrassment, alleviating their boredom and facilitating self-disclosure. Similarly, according to Flowers (2001), humor helps reducing stress in the classroom and increasing immediacy between teacher and students. In addition, Kelly (2005) states that humor increases interaction and participation in the classroom and it may have positive effects on comprehension. According to Gorham and Christophel (1990), there is no evidence for direct relationship between humor and retention. However, as an arousal agent, humor may indirectly affect retention through increasing attention. In a similar manner, Narula (2011) states attention span of students in a lesson that is roughly 15 minutes may be increased by the use of humor in the classroom. An increase in attention span may result in increased retention.

There are also some disadvantages of using humor in the classroom. Gorham and Christophel (1990) point out that using too much humor has a risk of losing respect and being perceived as a joker. In addition, according to Kelly (2005), humor, which is subjective in nature, has a potential of being offensive. Therefore, humor used in the classroom should be chosen cautiously not to be sarcastic or offensive to any group. Similarly, Wanzer et al. (2006) state that inappropriate uses of classroom humor are disparaging humor targeting any person and offensive humor. In other words, humor in which teacher disparages any person or group based on intelligence, gender, race, religion or appearance is perceived as inappropriate by students. Furthermore, although there is a strong belief that humor increases retention of concepts, Fisher (1997) observed that there is no significant effect of humor on retention of science concepts. In fact, non-humorous instructional material yields more retention than humorous one.

### *Comic Strips*

As mentioned above, comic strips are one of common humor carriers. There is some confusion in meanings of the terms in cartoon family. According to Tatalovic (2009), cartoon family is considered in four categories: single-frame cartoons, comic strips, comic books and graphic novels, in order of increasing length and complexity of narration. Rota and Izquierdo (2003) define comics as pictorial images placed sequentially to transmit messages. Similarly, Tatalovic (2009) simply defines comics as sequential art associated with text and comic strips as short sequences of images telling short stories.

As a media, some advantages and disadvantages of comics are mentioned in literature. According to Tatalovic (2009), comics enhance enjoyment of reading science. Another

advantage of comics is that this medium increases reading comprehension (Liu, 2004). In addition, Cheesman (2006) points out that starting a lesson by showing comic strips puts the students in a more receptive mood and starts critical thinking. Moreover, Rota and Izquierdo (2003) state that reading comics is not a passive activity in which readers think actively to fill the gaps between panels. On the other hand, according to Tatalovic (2009), one of the disadvantages of comics is that they allow only one-way communication. As another disadvantage, comics are inappropriate for dynamical concepts because they are composed of static images. Only a limited demonstration of movements by various supportive lines is possible. In addition, comics often present a message with stereotypical images. There are common stereotypes for certain jobs in comics. For instance, scientists are often drawn as a short man with glasses, messy hairs and moustache, holding a book (Tatalovic, 2009).

### *Teaching/Learning Sound*

It is a clear and reasonable assumption that students develop several preconceptions about many science concepts before school instruction. Reiner, Slotta, Chi and Resnick (2000) express that children enter into teaching/learning process with a series of well-defined conceptions most of which are formed by daily life experiences with substances. Therefore, children's preconceptions about science concepts including abstract ones are generally observed substance based. On the contrary, Eshach and Schwartz (2006) found that students' preconceptions about sound are not completely consistent with substance based schema. Students are observed to describe sound as pushable, frictional and containable like substances, however, they do not perceive sound as an ordinary substance with respect to particle nature, additive properties and inertial characteristics. Regarding discussions in the literature, it may be concluded that an instruction aiming to teach sound needs to focus on preconceptions based on substance view and ones conflicting it.

### *Research Question*

With respect to discussions above, it can be stated that comic strips may be used as learning aid in science classroom, however how instructional comic strips should be designed and developed with scientific methods is not answered well. The purpose of this study is to develop a series of humorous instructional comic strips about sound and to get preliminary evidence for whether they are useful in science course as learning aid. Results will be used as feedback for developing better instructional comic strips.

## **Methodology**

### *Methodological Framework*

This study is a "design and development" type research aiming to develop an instructional intervention based on an existing theory and get feedback for the development process (Institute of Education Sciences [IES], 2013). This study had two main stages: development and evaluation of comic strips about sound concepts. Briefly, development stage of the study included creative activities of writing scenarios and drawing comic strips with expert reviews. Evaluation stage included pilot implementation and analysis of participants' responses. In this stage, responses and reactions of participants to the implementation of instructional comic strips were investigated through qualitative content analysis. Development and evaluation stages of the study are explained below in detail.

### Material

In this study, six comic strips about sound were developed in several steps. First, a science concept that is appropriate for comic strips was looked for. As stated by Tatalovic (2009), science concepts are generally dynamic and thus inconvenient for comic strips that are composed of static images and in which reader should imagine the movements. In this context, as an example, static electricity may be accepted as appropriate for comic strips. However, in this study, sound related concepts that have somehow dynamic nature were chosen, because students were expected to imagine vibrations and propagation of sound easily.

In brief, phases of development were as follows: writing scenarios, drawing comics, reviewing by expert colleagues, and redrawing. The framework of the story was that a twelve-year-old know-all girl makes humorous dialogues with some other people about daily life situations related to sound. Each episode focused different sub-concepts of sound, namely, vibrations of sound sources, media that conduct sound, echo, frequency, intensity and speed of sound. After writing scenarios, all episodes were drawn by the researcher who is a comic artist. In each episode, drawings that help comprehension of sound concepts were consciously avoided such as vibration of drum skin or compression and rarefaction of air molecules. Because, in this study, it was aimed that instructional message is supported only by humor. Instructional drawings would surpass humor if they were used. After finishing drawings, some expert colleagues reviewed them with respect to appropriateness of humor for target age, scientifically correctness, clarity, grammar and spelling. In order to develop final versions of comic strips for pilot implementation, comic strips were redrawn according to critiques and suggestions from experts. Two examples of comic strips developed are shown in the figures below.

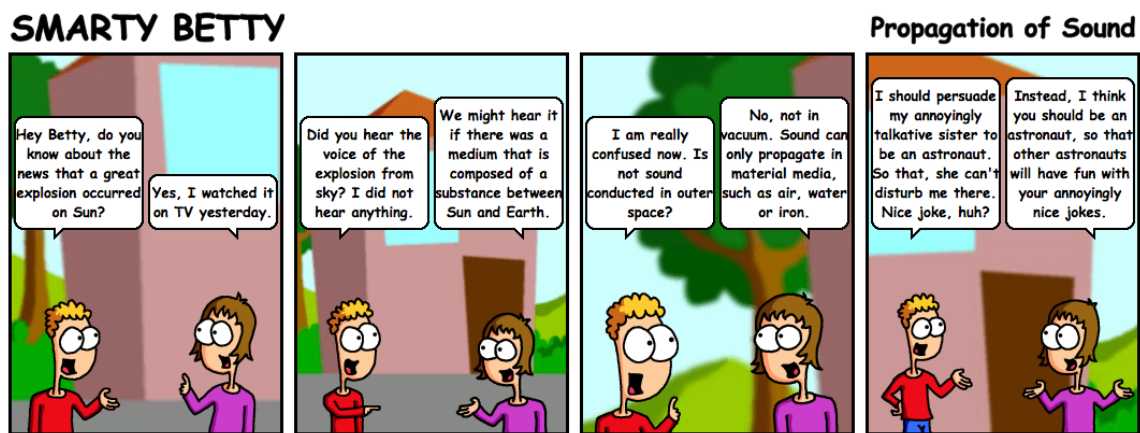


Figure 1. An example of comic strips developed in this study

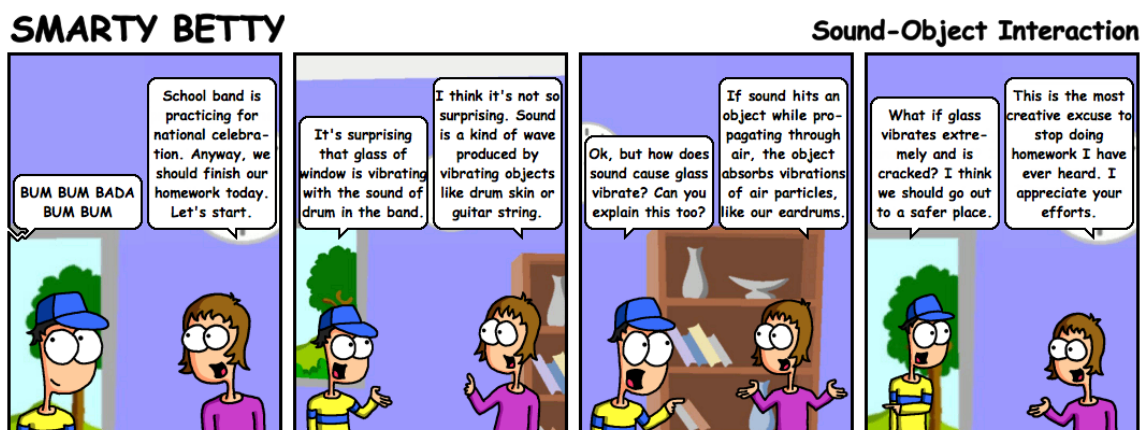


Figure 2. Another example of comic strips developed in this study

### Pilot Implementation

In the pilot implementation, participants are a group of students in three different 7<sup>th</sup> grade intact classrooms, which are chosen in a convenient middle school in Artvin, Turkey. In these classrooms, there were totally 55 students with the age of 13.

After getting official permission for the implementation, the researcher started observation in three selected classrooms in the selected middle school to recognize distinctive characteristics of participant students and to become a natural member of the classroom. After two-week observation, before sound chapter started in the normal flow of the semester, six comic strips printed on papers were given to students in a science lesson. After reading comic strips, students were asked to answer some open-ended questions about sound and comic strips. Open-ended questions about sound are listed in the table below.

Table 1. Open-ended questions about sound

#### Open-ended questions about sound

- S1. How is sound produced?
- S2. How do we hear?
- S3. How is echo produced?
- S4. In which media cannot sound propagate? Why?
- S5. What is the order of speed of sound in air, water and iron from high to low?
- S6. Explain your reasoning in the previous question.
- S7. What is frequency of sound?
- S8. Which feature of sound changes when the frequency is changed?
- S9. What is magnitude of sound?
- S10. What is the difference between frequency and magnitude?

In this study, there are two kinds of open-ended questions about sound. Questions whose answers are directly available in the comic strips are S1, S3, S4, S7, S8 and S9. These questions were asked to reveal whether the students understand comic strips truly or not. Questions that require guessing to answer are S2, S5, S6 and S10. These questions were asked to observe how comic strips help the students in connecting given concepts with each other and with not given ones.

In addition to questions about sound, students were asked some open-ended opinion questions about comic strips that are listed in table below.

**Table 2.** *Open-ended opinion questions about comic strips*

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**Open-ended opinion questions about comic strips**

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- O1. What did you like about using comic strips in science lesson?
  - O2. What did not you like about using comic strips in science lesson?
  - O3. What are the useful aspects of using comic strips in science lesson?
  - O4. What are the useless or harmful aspects of using comic strips in science lesson?
  - O5. How can the use of comic strips in science lessons be implemented better?
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In addition to these open-ended questions, the researcher observed classroom during the implementation, and an unstructured collective interview was done with the students in each classroom after the implementation.

*Data Analysis*

In this study, there are three sources of data: written answers of students to open-ended questions, collective interview with the students and researcher's observations during the implementation. Because all these data are in verbal form and patterns that may be qualitative feedback for developing comic strips are looked for, they were analyzed through qualitative content analysis. Written answers of all students, which are main data of the study, were coded for some categories in order to draw a meaningful pattern and to obtain useful feedback for development process of instructional comic strips. Researcher's observations and collective interviews, which are supplementary data of the study, were used to ensure the pattern in data from open-ended question. In other words, the aim was to establish validity of the results through data triangulation by using three different sources of data. In this study, quantitative analyses were avoided because numeric results would not provide in-depth and detailed feedback for development process of instructional comic strips.

**Results and Conclusions**

*Findings from Open-Ended Questions about Sound*

After reading the comic strips, the questions in Table 1 were asked to students. As mentioned above, the answers of some questions are directly available in comic strips, however some questions require guessing. As expected, most of the students answered questions whose answers are directly available in comic strips correctly. Therefore, it may be stated that comic strips do not have a problem related to comprehensibility. The focus of this study was on students' correct answers to guessing questions and their wrong answers to all questions. It was assumed that students' correct or partially correct predictions and their wrong answers to the questions are more helpful in revealing how

humorous comic strips contribute to students' comprehension of sound related concepts. Letters and numbers in parenthesis show respectively classroom code and students' code number. There are three classrooms coded as A, B and C. Therefore, A5, for example, means student with code number 5 in classroom A.

One of the most important findings in answers to open-ended questions about sound was that some students (A2, A4, A5, A10, A14, A15, A19, B2, B17, C7) related speed of sound with density, closeness of particles or states of matter, although there is no information in comic strips about it. For instance, C7 stated that "vibrations are conducted faster in iron because the atoms of iron is closer to eachother". These partially correct predictions may be related to previously learned information about sound from resources out of school, however it can be said that comic strips helped some students make correct connections among concepts available and unavailable in comic strips.

In addition, students used some important alternative words, which are not available in the comic strips. For instance, some students (A13, B1, B2, B4, B10, C13) explained intensity of sound with the alternative keywords, such as whisper, yelling and voice away. These keywords may be considered as indicators of students' comprehension of intensity concept. Students seem to use these alternative words with respect to association of ideas in comic strips.

Another remarkable finding was related to a wrong prediction about the speed order of sound in air, water and iron. Some students (A3, A6, A7, A9, A11, A13, A16, B4, B6, B7, B8, B10, B11, B12, B16, B20, C1, C3, C4, C5, C6, C11) stated that sound propagates in water at the lowest speed. This interesting prediction may be based on past experiences, because two students (B10, B16) explained their speed order prediction with the idea that it is difficult to hear well inside water. For example, B10 expressed that "sound moves in iron very fast but people can not hear anything inside water". In addition, two students (A7, C6) claimed that water vibrates less than the other two media. Also, a student (B6) stated that there are more obstacles in water to conduct sound than the other media. As a result, there seem to be a common preconception about speed of sound in water, and comic strips did not provide a learning atmosphere for correct predictions.

Another wrong prediction made by some students (A1, A18, B1, B13, B19, C13, C15) was that speed of sound in air, water and iron decreases respectively; although it was clearly described in comic strips that sound propagates in iron much faster than air. Most probably these students intuitively established an inverse relationship between speed of sound and density of medium. Actually, three of them (B1, B13, C13) formally claimed this inverse relationship in their answers. For instance, the response of B13 was that "speed of sound in air > water > iron, because their densities are lined up from low to high". This interesting observation may be considered as evidence how preconceptions are persistent. As a result, humorous comic strips seemed to be inappropriate for correcting this preconception.

#### *Findings from Open-Ended Opinion Questions about Comic Strips*

Although participants were asked five open-ended opinion questions that are listed in Table 2, it was observed that they wrote their positive and negative opinions and their suggestions randomly in all questions. Therefore, all of the answers of each student were considered as one text including his/her positive and negative opinions and suggestions about the use of comic strips in science lessons as learning aid.

Students' negative and positive opinions were considered separately. Because, their positive opinions will be used as feedback that should be in the development of comic

strips and negative opinions will be used as feedback that should be avoided. Students' positive opinions are classified and coded in Table 3 below.

**Table 3.** *Students' positive opinions in the open-ended questions*

<b>Categories</b>	<b>Subcategories</b>	<b>Opinions</b>
	Comic strips increase retention (RET)	They are easily memorable (A5, A7, A9, A11, A14, B6, C2, C3, C4).
Comic strips help learning (LEA)		They make me understand topic better (A1, A9, A11, B5, B6, B8, B11, B16, B18, C10).
	Comic strips increase comprehension (COM)	They are easily understandable (A2, B12, C11, C14). They summarize the topic shortly (C3, C7, C14). They teach the topic quickly (A7, C9, C11). They are visual (A5, A19, B7). They include daily life examples (B16).
Comic strips increase students' attitude toward science (ATT)		They are entertaining and instructive at the same time (A3, A5, A10, A13, A15, B3, B8, B17, C2, C4, C8, C12, C13). They make science lesson funnier (A19, B3, B5, B9, B10, C1, C5, C9).
	Comic strips increase enjoyment (ENJ)	They are funny (A12, B2, C6, C14, C15). They make me like science course (A13, C1, C8, C14). They make science lesson more colorful (A2, B9). They are humorous (A15, C15). Their drawings are cute (C11). Characters are kids in these comic strips (B2).
Comic strips increase students' attitude toward science (ATT)	Comic strips support perception of success (PER)	They increase achievement in science (A9, A13, B8, B19).
	Comic strips increase curiosity and attraction (CUR)	They are attractive and attention getting materials (A3, A7, A11, A12, A17, A19, B19, C9, C11). They make me want to read (A11, B12, B19). They help me focus on the lesson easily (A13, A14, B10). They are intriguing (B6, C1, C5).
	Comic strips increase importance (IMP)	They increase the importance of the course that students give (A16, B8).



Students' positive opinions were classified into two categories that are comic strips help learning (LEA) and comic strips increase students' attitude toward science (ATT). LEA was divided into two sub-categories namely comic strips increase retention (RET) and comic strips increase comprehension (COM). LEA may be briefly described that comic strips help students' learning by increasing retention and comprehension. For example, A5 claimed that comic strips increase retention of concepts.

"With this visual aid, topics are more memorable, we can remember them easily and we do not forget them for a long time." (A5)

In addition, according to C7, comic strips help comprehension through simplifying topics.

"Comic strips explain long and complicated science topics shortly and effectively." (C7)

It was also found that students' attitude toward science (ATT) was divided into four categories that are students' enjoyment of science (ENJ), students' perception of success (PER), students' curiosity about science (CUR) and students' belief in importance of science (IMP). ATT has a meaning that comic strips increase students' attitude by increasing enjoyment, perception of success, curiosity and importance. The answer of A13 that is available below simply summarizes how comic strips contribute to students' attitude toward science.

"Sometimes science course is boring. It has no fun. Therefore, we are bored in the classroom. We have fun and learn at the same time with comic strips. I think they are very useful. A person who hates science will like it and surely succeed it with the use of comic strips. I also think using comic strips in science lessons is very creative idea. They make me like science course. If I liked science I would get better grades too. If there were comic strips in each chapter of textbook, no students would be bored. I would really want the course to be like that. Surely, science course would be funnier for me and I would easily focus on the lesson." (A13)

In addition to students' positive opinions, their negative opinions are classified and coded. Classification and coding of students' negative opinions are shown in Table 4 below.

As seen in Table 4 above, students' negative opinions were classified into five categories that are comic strips do not have a good scenario (SCE), comic strips are difficult to read (REA), comic strips are difficult to understand (UND), comic strips decrease discipline (DIS) and comic strips do not have good drawings (DRA).

SCE was divided into two subcategories, comic strips have a nonsense scenario (SEN) and comic strips have a scenario that is not funny (FUN). This simply means that scenarios of comic strips were nonsense and not funny for some students. Some students found the scenarios as nonsense, because the idea of an academically know-all girl may be culturally weird and antipathetic. Some other students found that scenarios are not funny. Actually, this may be a normal situation, because it is really hard to create humor valid for all.

In addition, some students thought that implemented comic strips were difficult to read (REA) because of the amount of text (TXT) and font size (FON). Telling more with less word in comic strips is a difficult-to-achieve but must-have situation. The critiques about the amount of text and font size will be used as feedback in development of new comic strips in the future. Similarly, implemented comic strips were difficult to understand (UND) for a few students. Difficulty in comprehension may also be related to the amount of text and font size. Because, according to Baker and Wigfield (1999), one of the dimensions of children's reading motivation is avoidance of reading long text. Possibly, students' avoidance of long text affected comprehension of comic strips negatively in this study.

**Table 4.** *Students' negative opinions in the open-ended questions*

Categories	Subcategories	Opinions
Comic strips do not have a good scenario (SCE)	Comic strips have non-sense scenario (SEN)	Main character is a know-all kid (A1, A5, A10, A11, B13, B20). Scenario is silly (B18, C2).
	Comic strips have scenario that is not funny (FUN)	Scenario is not humorous (A8, B5, B19). Scenario is boring (C2).
Comic strips are difficult to read (REA)	Comic strips have too much text (TXT)	There is too much text in comic strips (A14, A17, B5). Reading comic strips are time consuming (A19).
	Comic strips have font with too small font size (FON)	Font size of text in comic strips is too small (A18, C11).
Comic strips are difficult to understand (UND)	-	Comic strips are not comprehensible (B12, B14, B15). Comic strips are not explanatory (C4). Comic strips rack my brain (B5).
Comic strips decrease discipline (DIS)	-	Comic strips decrease severity of lesson (B19). Comic strips prevent students from doing homework (C6).
Comic strips do not have good drawings (DRA)	-	Drawings are not enjoyable (A4, A6, C7).

One of the most interesting results of students' opinions about comic strips was the idea that comic strips decrease the level of discipline in studying science (DIS). The opinion of C6 simply explains the relationship between discipline and comic strips.

*"I think comic strips do not have positive effects on science course. They may prevent students from studying the course topics. Students will always want to read them and try drawing them. Therefore, students will participate less on the lesson activities."* (C6)

The opinion above is ironic for this study. It is a direct criticism toward using comic strips as learning aid because of students' strong tendency of reading them, however according to present study, that is the reason why comic strips should be used in science classroom. This controversial situation may be related to the perception of science and humor in general. In formal education and other sources of scientific knowledge, science is presented to students as a dangerous job performed by serious people in laboratories (Turkmen, 2008). This stereotypical image of science may support the opinion that humor decreases seriousness of science. In contrast, humor, according to present study, is perceived as an important component of science learning process that may have great contributions on it.

In addition to positive and negative opinions, students also made some important suggestions in their answers to open-ended questions. Some students (A7, A13, A14, B6, B12, B17, B18, C11) suggested that it would be great if comic strips were available in course textbooks. This suggestion is a strong indicator of students' enjoyment toward comic strips and their negative opinions about current science textbooks. It is an important finding that has some inevitable implications to textbook authors and publishers. In addition, two students (A4, A19) thought that cartoon animations would be better than comic strips and a student (A5) suggested that comic strips might be transformed into a video game. Because, cartoon animations and video games are probably more appropriate for the dynamic nature of teenagers. In order to create comic strips that are more convenient for teenagers, the story would include more action.

#### *Findings from Observations*

As mentioned above, in all three classrooms, the researcher observed students while they were reading comic strips and answering open-ended questions. During reading session, one of the most important observations was that the students read comic strips in an absolute silence. This may be an indicator of their curiosity and interest about reading comic strips. As stated above, students' strong tendency of reading comic strips is why they should be used in science classroom. Another important observation was that most of the students put comic strips in their bags at the end of the lesson, while they leaved textbooks, notebooks and the other stuff on desk. It seemed the students wanted to keep comic strips and take them to home, which may indicate the importance of comic strips for the students. In general, these observations support the results from open-ended questions, which may be another evidence for validity of the results.

On the other hand, it was observed that students did not laugh while reading comic strips, although most of them reported that comic strips are humorous in their answers to open-ended questions. Actually, some of them only smiled, however most of them just read comic strips carefully without facial expression. It is probably because of inadequate intensity of humor in the comic strips for laughing, nevertheless it seems that this observation does not support the results from open-ended questions.

#### *Findings from Collective Interviews*

Some students might have difficulties in describing their opinions in written answers. Therefore, in each classroom, a collective interview with students was done after reading comic strips in order to give them opportunity to express themselves vocally. During the interview, most of the students agreed that comic strips made reading funnier and humorous dialogues were cute. Additionally, students believed that comic strips help comprehension of science because they briefly describe scientific concepts through simple daily life situations. Moreover, most of the students agreed that it would be great if famous cartoon characters were used in the comic strips. As expected, using famous cartoon characters in comic strips is impossible because of limited budget of this study. However, this is a direct feedback for commercial cartoon studios pointing out that they may consider creating academically relevant episodes of famous cartoons or comics directly usable in science courses.

At the same time, some students stated that childish characters and exaggerated drawing style in the comic strips would be more appropriate for lower classes. They believed that there should be cooler characters and realistic drawing style in the comic strips. These opinions are strong criticisms toward comic strips developed in this study and they certainly should be taken in consideration. Probably, most of seventh grade students define themselves as individuals in the beginning of young adulthood and they have a

strong reaction to anything, which is related to childhood. Therefore this finding should be considered in the comic strip development process.

In general, students delivered similar opinions to the written answers to open-ended questions during the interview. In other words, there seem to be a parallel relationship between the results of open-ended questions and collective interview, which may be considered as an evidence for validity of the results.

There is always a probability that opinions of some students especially group leaders may influence other students in collective interviews. However, during the observation before and during the implementation of comic strips, it was observed that democratic atmospheres exist in all three classrooms. In addition, opposing opinions were observed in each classroom during collective interview showing that there is not a dominant opinion in each classroom. Therefore, the results of collective interview did not seem to have a significant problem for the validity of the results.

### *Conclusions and Suggestions*

As explained in introduction section of this paper, previous studies showed that children's common preconceptions about sound are often substance based because they are originated from children's daily life experiences with substances (Renier et al., 2000, Eshach and Schwartz, 2006). Findings of the present study seem to agree with this conclusion. For instance, some of the participants wrongly stated that sound propagates the fastest in air and the slowest in iron although the correct speed order is given in comic strips. This finding may be because of the substance view of sound implying that lighter substances move faster than heavier ones. In addition, many of the participants claimed that speed of sound in water is lower than that in air and iron. This finding seems to be originated from participants' previous daily life experiences with water probably while swimming or diving.

The only purpose of elementary science course is not to teach science. Two of the other purposes of science courses may be defined as to increase students' enjoyment of science and their perception of success in science. In this study, it was clearly observed that humorous comic strips make science course funnier for most of the students. It was also found that some students believe they can focus on the lesson more easily and learn better when comic strips are included in the science course. Although there are no experimental evidences for a positive effect of comic strips on students' science achievement, comic strips at least seem to have a contribution on students' enjoyment of science and their perception of success in science.

In general, it was observed that comic strips promoted learning atmosphere in science classroom. However, it was also noticed that there are some important considerations while developing humorous instructional comic strips. With respect to the findings of this study, suggestions for developing instructional comic strips are summarized in Table 5 below.

At this point, it is convenient to remind that there are no experimental evidences for the interpretations of findings in the present study, because the sources of data are mainly students' opinions and researcher's observations. Therefore, these interpretations should be considered as preliminary evidences for the use of comic strips as learning aid. Students' opinions about comic strips might be highly affected by novelty effect, because, comic strips are indeed new learning materials for the existing science classrooms in Turkey. In addition, all participants of this study were the students of a school in a district in which families with relatively high socio-economic status live. The opinions of students from families with low socio-economic status were not investigated in this study.

Therefore, there is a need for experimental research studies that investigate the effect of comic strips on science achievement and attitude toward science controlling all possible extraneous effects.

**Table 5.** *Suggestions for Developing Instructional Comic Strips*

<b>Finding</b>	<b>Suggestion</b>
Some students found humor in the comic strips childish.	Humor should be appropriate for target age.
Some students thought that drawings are unrealistic.	Caricature style exaggerated drawings might be more convenient for lower ages.
According to some students, there is too much text in speech bubbles and font size of text is too small.	This situation probably causes reading avoidance that may affect comprehension of text negatively. Thus, comic strips should include minimum amount of text with an appropriate font size.
Some students did not like leading character who is a know-all girl.	Children have a tendency of equating themselves with the leading characters, therefore leading characters in comic strips should not be antipathetic for students. The leading character with a cooler personality may be better for teenage readers.
Some students stated that cartoon animations or video games would be better instructional material than comic strips.	Animations and video games are more appropriate for dynamic nature of teenagers. Hence, scenario and drawings should include action in comic strips.

In this study, it was concluded that developing any kinds of humorous learning material is difficult to accomplish and needs careful considerations in development process. Because, humor is sensitively relative to the age, gender and socioeconomic background of individuals, culture, traditions and political agenda of society. Nevertheless, it seems possible to develop academically relevant and appropriately humorous comic strips that may contribute to learning atmosphere in the science classroom.



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