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Dear reader,

it is my pleasure to present the issue of COMMUNICATIONS – the Scientific Letters of the University of Zilina focused on Approaches for Interdisciplinary Teaching.

The contributors concentrated on illustrating problems and solutions concerning the topic rather than their theorisation. Thus the whole issue perfectly exemplifies the symbiosis of teaching practice and theory. Readers of the journal may put a question to themselves – what is in a name “interdisciplinary”. Part of the reason is the institutional tendency of the University of Zilina to integrate arts, humanities and sciences within comprehensive educational context.

I believe the journal has been very successful in bringing together researchers from many fields who share a common interest to fulfill the need for thorough discussion of research in relevant disciplines. It is gratifying to see how much it has grown both in terms of readership and of the quality of publications. These high standards have been possible due to the authors who submit their research to us, and to our great team of editors and proofreaders who make sure all published articles are of the high standards our readers expect.

I would like to thank the authors, the editors and the proofreaders for their efforts in putting this edition of the COMMUNICATIONS together. I hope you enjoy reading the articles.

Zdena Kralova

Jana Lopusanova *

COMMUNICATION ACROSS NATIONS

These days goods, capital, and labor move freely across borders. During the last forty years international trade has increased by 1500 % as tariffs have fallen from 50 % to less than 5 %. That is why multinational companies like Exxon do two-thirds of their business outside the US and components for the new Ford come from fifteen different countries. The management of global companies as well as the management of brands internationally has partly become a cross-cultural issue where communication across nations takes the crucial role on the way to success.

Keywords: Cultural awareness, communication, language, culture, management, multi-nationals.

1. Introduction

While thinking of currently happening globalization processes *The Economist* [1] has identified these key contributors to globalization:

- *free movement of capital* "at the touch of a button" which is the fuel of investment in all its forms,
- *trade liberalization* with lowering of trade barriers,
- lowering of *shipping costs* thanks to the efficiency of containerization,¹⁾
- reduction in *telecommunications* and *computing cost*.²⁾

Organizations with the *resources* and expertise to exploit the information on their networks on a worldwide scale will have a key competitive advantage in many industries. Operating in and producing for not only one country, or even one continent, allows a company to reduce costs and benefit from *economies of scales*.

Some implications of this for managers have been suggested by points raised in a series in the *Financial Times* [2]. Even in a company that operates within one country, there is often resistance to ideas from outside, the *not invented here syndrome*; and with *subsidiaries* in many countries, this becomes more of a problem, because it is compounded by *cross-cultural issues* and potential misunderstandings. Resistance to the way of doing things elsewhere may be even stronger if the subsidiary was previously a local company taken over by a multinational, perhaps with loss of jobs

and loss of sense of security among those that remain. The management of global companies (as well as the management of brands internationally³⁾) is partly a cross-cultural issue. Developing international teams of managers working in a multicultural environment has become a challenge.

2. Managing across cultures

As the world gets smaller, we need to learn more about each other's values, beliefs, habits and expectations. Culture is, in the famous phrase, *the way we do things around here* [3]. The "here" in question may be a country, a region, a social class, a company, a university. Clearly, we each live in a set of *cultures* and *subcultures* that interlock in complex ways, and, to make a generalization, one of the most dangerous thing is to generalize about them. *Stereotypes* are, of course, to be handled with caution. The stereotype may represent the middle of a range of different behaviors, it may be at one extreme, or it may just not be true. And there may be more variety in behavior within a culture than between one culture and another.

Neighboring countries or regions, or two companies in the same industry, tend to see themselves as very different to each other, but that difference is hard for the outsider to grasp at first glance. A few years working in one of the two places will make seem more apparent, as one gets "involved" in one of the cultures. One can

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¹⁾ The shipping charge for a whole container of goods crossing the Pacific can be as little as \$50. The transport cost for each "Japanese" TV, probably made in Malaysia or elsewhere, sold in the US or Europe is negligible.

²⁾ The cost of a 3-minute phone call from New York to London in 1930 was \$300 in today's money. There is more computing power in the average wrist watch today than there was in all world's computers in 1950.

³⁾ A **brand** like Coca-cola has been around for a long time, and dominates the fizzy market in almost every country, outselling local brands. One exception is Scotland, and their marketing specialists are trying to find out why this is, in an international market that should by now be truly **homogenous**. Anomalies such as the French preference for top-loading washing machines when the rest of Europe prefers door-loading ones, or the American liking for 4x4-type vehicles rather than saloon cars, even in cities, could be related to the smallness of French apartments or the cheapness of American petrol. But there have always been **cultural "traditions"** that are harder to explain. Why do Spanish drink so little tea? Why do Germans eat so many bananas?

also think of promoting the same corporate policy at a global level, fostering diagonal promotions as well as geographical relocation of managers three or four times in their first dozen years which can help a multinational corporation to become global, cultural aware and sensitive.

Here (in no particular order) are some *cross-cultural issues*, areas where there are variations in behavior across different cultures, and some examples of the ways they relate to the business world: [4]

- *Religion*: is it expected of people or a matter of individual choice: Does it play a role in business life?
- *Roles of men and women*: are women often found at the highest levels of business and society?
- *Hierarchy*: what is the distance between managers and people who work for them?
- *Levels of formality* in language and behavior: is there an elaborate system of levels of deference in addressing different people?
- *Conversation*: settings (formal and informal meetings, social situations, etc.) turn-taking, periods of silence, proximity, body language, eye contact, showing emotions, saving face, using first names, role of humor, small talk, etc.
- *Dress* for different settings and occasions: is the business suit essential?
- *The relation of work to private life*: are spouses expected to attend certain types of company events? Do business people invite colleagues and contacts to their houses, or is everything done in the office and restaurant? What about working extra hours, giving gifts, exchanging business cards, taking shoes off, etc.
- *Time*: time scale of the activity/organization, planning the working day/week/year, meals, recreation, holidays, etc. Do meetings start on time? What about the summer break? etc.

One can also ask and answer a question how important the following characteristics might be at a workplace or for doing

business in a foreign country? It is possible to think which of them are very, less or not important and which should rather be avoided.

We can think of: [5]

After having a discussion on the above mentioned characteristics one can possibly get a fair picture of its own or foreign culture or company's business behavior within one culture.

Cultural management has become a crucial issue nowadays. Meeting members of other culture can on one side be very helpful in getting practical experience in knowing and understanding new/different culture but, on the other hand, cultures differ which might be the source of misunderstandings. And everyone (not only in business) should be aware of this. Many books on multi/cross-cultural management suggest that the world can be divided into three geographical groups:

North America [1]

Europe, Latin America, Middle East [2]

Japan, China, East Asia [3].

Based on surveys carried out on various intercultural differences we can try to characterize these groups of countries and describe them from these points of view:

- Company values
- Business relationships
- Meetings
- Presentations. [6]

Company values

- Group harmony, long-term relationships, loyalty, company reputation. [3]⁴⁾
- Trust between individuals, compromise, and personal reputation. People work to live. [2]
- Competition between individuals, achievement, action, risk-taking, directness, informality, innovation. People live to work. [1]

	Not important/ to be avoided	Very important
• using first names	<----->	
• punctuality	<----->	
• physical contact	<----->	
• humor	<----->	
• giving gifts	<----->	
• socializing outside work	<----->	
• physical appearance	<----->	
• small talk	<----->	
• showing emotions	<----->	
• working extra hours	<----->	
• appearing to be busy	<----->	
• formality between levels in the company's hierarchy	<----->	

Table 1 Work place characteristics

⁴⁾ Numbers given at the end of the utterances apply to the culture where these standards are common according to the above mentioned division of the world into three geographical groups.

Business relationships

- Friendly and informal, but a continuing personal relationship is not important. Much business is done over the phone. [1]
- Done on a group basis, although relationships based on mutual respect are important. Often there is an older authority figure that rarely appears but has ultimate power. [3]
- Personal relationships are very important. Some time is needed to build trust before business can begin. There is preference for doing business face to face. [2]

Meetings

- Objective is to gather information. Communication is often “monologue – pause – monologue” rather than dialogue. Arguments are often indirect, and there are no sudden changes of viewpoint in meetings. Decisions are made by group consensus over a long time period. [3]
- Objective is to make a deal or decision. Communication style is direct, factual, informal and at times confrontational. Decisions are based on facts, and are often made instantly in the meeting. [1]
- Objective is to establish relationships, build understanding, clarify, and issue instructions. Communication style depends on national culture. Decisions are made by key individuals, outside the meeting. [2]

Presentations

- Complicated language may be used to show education. Audience expects formality and a logical structure, but a touch of imagination is also appreciated. May want a more personal “extra” talk afterwards where you tell them the “truth”. [2]
- Indirect, conservative language. Audience appreciates a quiet, formal presentation with visual aids and lots of opportunity to ask questions and check understanding. They expect separate handouts, prepared for different people, by job function. [3]

- Direct, simple language. Audience expects jokes, modernity, logic, slogans, informality and a hard sell. Audience may ask questions or interrupt while someone is speaking, and will openly question inconsistent facts. [1]

3. Communication tools for understanding cultures

Definitely there are differences in speaking and communication styles and tools among cultures as well. We in this context mean culture not in the sense of literature, music or art but in the sense of system of shared attitudes, beliefs, values or behavior. Culture manifests itself both in patterns of language and thought and in forms of activity and behavior. These patterns have become models for common adaptive acts and styles of expressive behavior which enable people to live in a society within a given geographical environment and at a given state of technical development. Culture as well can be viewed as a communication problem, because it is not constant but it varies. And as cultural variance increases, so do the problems of communication [7].

In *When Cultures Collide* cross-cultural consultant Richard D Lewis [8] talks about the role of small talk⁵⁾ in international business. The diagram below shows how long it takes different nationalities to get down to business.

Communications expert Fons Trompenaars [9] in his work *Riding the Waves of Culture*, shows how different cultures have different discussion styles. The diagram below illustrates his results. The lines represent two speakers and the spaces represent the silences. When lines and spaces overlap it shows that people are speaking at the same time [10].

State/culture	
Germany	→ Formal introduction. Sit down. Begin.
Finland	→ Formal introduction. Cup of coffee. Sit down. Begin.
USA	→ Formal introduction. Cup of coffee. Joke. Begin.
UK	→ Formal introduction. Cup of tea and biscuits. 10 min talk (weather, sport). Casual beginning.
France	→ Formal introduction. 15 min small talk (politics, scandal). Begin.
Japan	→ Formal introduction. Formal seating. Green tea. 15–20 min small talk (pleasantries). Signal from superior. Begin.
Spain/Italy	→ 0 – 30 min small talk (football, family) while the others arrive. Begin when everyone is there.
Min →	0 5 10 15 20 25

Diagram 1 Small talk

⁵⁾ Small talk is a social dialogue held at the beginning of a meeting or a business negotiation, often called chit-chat as well. In different cultures the role of small talk is different.

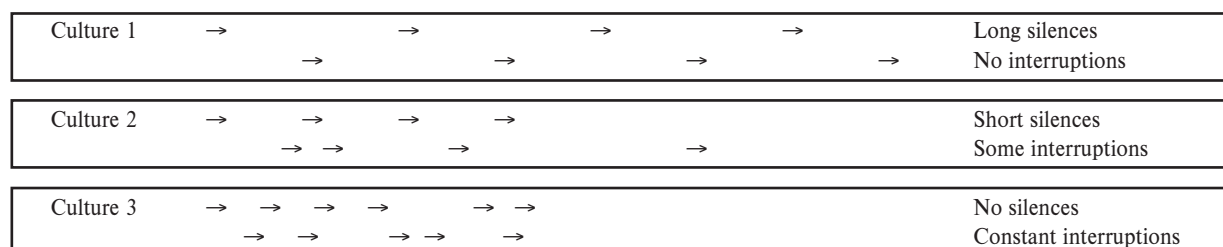


Diagram 2 Discussion style

As the intercultural communication is not yet a part of the language preparation at schools or universities it is becoming a crucial issue what can cause a bigger problem: to be the best at vocabulary, grammar and functions, or to be able to understand cultural differences, be able to greet in an appropriate way, with the correct intonation, handle business cards, respect others and understand that the English language is what we call a bridge for meeting other cultures but at the same time be aware that English is not the only tool that is available. There has been a significant rise in the meaning of the *non-verbal communication* as well. And this is where we see the future of the foreign language teaching and language preparation going hand in hand with providing practical examples and information from the area of cross-cultural management and economy in the sense of respecting and understanding cultures.

"The most important thing in communication is to hear what isn't being said". That, at least is the opinion of management guru, Peter Drucker, for most of us, hearing what is being said is quite difficult enough. Part of the problem is that languages are spoken at very different speeds. Polynesians belong to some of the world's slowest speakers, converse at a leisure 100 syllabus a minute. The English too take their time at 150 to 200. Germans on the other hand, can often manage a swift 250. French and Spaniards race along at 350 syllables a minute. Surprisingly, the Japanese speak at "almost Spanish" 300 syllables. But that doesn't take account of the long periods of silence they are also famous for. Some of these can last nearly a minute themselves, for in Japan silence is just another form of communication. That's why one should never interrupt it [11]. (Silence together with the speed, rate, intonation, pauses, paralinguistic elements, gestures, posture, distance, saving face phenomenon, etc. all belong to the area of non-verbal communication.)

According to various authors there are *tools for understanding cultures*. First of all we need to be cultural fluent. Cultural fluency means understanding what culture is, how it works, and the ways culture and communication are intertwined with conflicts.

Even if this may sound simple, it does require some effort. Hall [13] writes in the introduction to his book, *The Dance of Life*, that we should reorganize our thinking and that only few of us are willing to risk such a radical move. Communication theorists, anthropologists, and others have given us tools to develop our cultural awareness.

In the next part we would like to explore two of them here:

- High and low context cultures
- Cultures based on individualism and cultures based on group harmony.

High-context and *Low-context communication* refer to the degree to which speakers rely on factors other than explicit speech to convey their messages. This tool was developed by E. T. Hall and it suggests that communication varies according to its degree of field dependence, and can be classified into two categories: high-context and low-context. Field dependence refers to the degree to which things outside the communication process influence meaning.

E. T. Hall says that humans are confronted by many sensory stimuli. Cultures help in process of screening messages, shaping perceptions and interpretations according to a series of filters. In high-context settings, the screens are designed to let in implied meanings arising from the physical setting, relational cues, and shared understandings. In low-context settings, the screens direct attention more to the literal meanings of words and less to the context.

We have to be aware of the fact that we get involved in both high-context and low-context communication. Sometimes people exactly say what they mean, and mean what they say and leave very few explicit messages, which is an example of low-context communication.

At different times people use nonverbal communication more, do not (want to) say exactly what they mean, use indirect messages which is an example of high-context communication.

When people communicate they are more or less explicit and direct and move between high and low context depending on the relationship, situation, and/or the purpose of communication. In close relationships, when people know one another well, communication can be high context, indirect, hard to understand for an outsider... With new people, our conversation is more direct, explicit and based on words and their exact meaning.

Low- and high-context communication can be used to understand different cultural groups. We distinguish low/er context cultures: are German, Scandinavian, American, English Canadian and high/er context cultures: French Canadian, French, Italian, Spanish, Mexican, Greek, Arab, Chinese, Japanese, Korean.

Generally said, Western cultures tend to move towards low-context starting points, while Eastern and Southern cultures tend to use high-context communication which is why there are so many important differences. In high-context communication settings, it is necessary to pay great attention to nonverbal signals and behavior of others communicators involved. In low-context communication settings directness plays the key role.

“The choice of high-context and low-context as labels has led to unfortunate misunderstandings, since there is an implied ranking in the adjectives. In fact, neither is better or worse than the other. They are simply different. Each has possible pitfalls for cross-cultural communicators. Generally, low-context communicators interacting with high-context communicators should be mindful that

- nonverbal messages and gestures may be as important as what is said;
- status and identity may be communicated nonverbally and require appropriate acknowledgement;
- face-saving and tact may be important, and need to be balanced with the desire to communicate fully and frankly;
- building a good relationship can contribute to effectiveness over time; and
- indirect routes and creative thinking are important alternatives to problem-solving when blocks are encountered.

High-context communicators interacting with low-context communicators should be mindful that

- things can be taken at face value rather than as representative of layers of meaning;
- roles and functions may be decoupled from status and identity;
- efficiency and effectiveness may be served by a sustained focus on tasks;
- direct questions and observations are not necessarily meant to offend, but to clarify and advance shared goals; and
- indirect cues may not be enough to get the other's attention.

If communicators are aware of high-context and low-context communication in their relations, conflicts may be lessened and even prevented.” [14]

Individualism and communitarianism is the second dimension we want to examine because we think it might be another source of a possible conflict and misunderstanding.

In *communitarian/collectivist settings* children are taught that they are part of a circle of relations. They identify themselves strongly with the group, its norms, values, dependence, and cooperation. Duty, honor, and deference to authority are to be respected. Wherever they may go, their identity being a member of their group goes out in front.

Individualist patterns involve ideas of being on one's own, independent, self-directed, autonomous, it represent someone who is able to make proposals, concessions, and maximize gains in his/her own self-interest. Children and youngsters are praised for their initiative, achievements, and individual leadership. They have a free option concerning their own preferences.

“Individual and communitarian identities are two quite different ways of being in the world. They connect at some point, of course, since all groups are made up of individuals and all individuals find themselves in relationship with various groups. But the starting points are different. To discern the basic difference, ask yourself which is most in the foreground of your life, the welfare, development, security, prosperity, and well-being of yourself and others as individuals, or the shared heritage, ecological resources, traditional stories, and group accomplishments of your people? Generally, those who start with individualism as their beginning tend to be most comfortable with independence, personal achievement, and a competitive conflict style. Those who start with a communal orientation are more focused on social connections, service, and a cooperative conflict style” [15].

According to M. LeBaron one possible way to know and distinguish communitarian or individualist starting points is to listen to their forms of greetings and addresses. “Thomas Morning Owl, a member of the Confederated Umatilla Tribes in Oregon, reports that his response to the question ‘Shinnamwa?’ (Who are you?) would not be his name, but a description of his father, mother, and tribe, and the place they came from. Morning Owl reflects that individual identities are subsumed into the collective in his culture: “Who preceded you, is who you are.” [16].

Representatives of collectivist cultures place less importance on relationships with outsiders, (strangers, casual acquaintances) than individualists. In Japan, attention is focused on maintaining harmony and cohesion with the group. (Compare with a Japanese proverb “None of us is as smart as all of us.”) The U.S. American behavior of friendliness towards strangers might be seen inappropriate and too familiar by people from communitarian settings, whereas U.S. Americans find social networks in communitarian settings very difficult to penetrate. And this phenomenon can also be a source of a possible misunderstanding across cultures.

“No matter which starting point seems natural, it is important to keep the entire continuum in mind when trying to understand and address conflict. From each vantage point, it is useful to remember some things:

From an individualist starting point,

- achievement involves individual goal-setting and action;
- I am ultimately accountable to myself and must make decisions I can live with;
- while I consult with others about choices, I am autonomous: a discrete circle; and
- I believe in equality and consider everyone able to make their own personal choices.

From a communitarian starting point,

- maintaining group harmony and cohesion is important, and my decisions should not disrupt that;
- choices are made in consultation with family and authority figures and their input is weighted as heavily, or even more heavily, than mine. I am an overlapping circle amidst other overlapping circles;

- my decisions reflect on my group and I am accountable to them as a member; and
- I notice hierarchy and accept direction from those of higher status than myself.

With these differences in mind, it is important for individualists to recognize the web of relations encompassing the communitarian party to a conflict, and to act in recognition of those. Similarly, it is helpful for those from communitarian settings to remember that individualists value autonomy and initiative, and to act in ways that respect these preferences" [17].

Furthermore we can distinguish between:

- Linear-active, multi-active and reactive cultures
- Cultures with "monochronic" or "polychronic" attitude towards time
- Cultures with different time-orientation, etc.

G. Hofstede [18] has found five dimensions of culture in his study of national work related values: low vs. high power distance, individualism vs. collectivism, masculinity vs. femininity, low vs. high uncertainty avoidance and long vs. short term orientation.

R. D. Lewis [19], author of many classic works in cross-cultural communication, has significantly broadened the phenomenon of global business and communication. In his work *When cultures collide* he captures the rising influence of culture and changes throughout regions of the world. Famous for his LMR model he gives leaders and managers as well as teachers practical strategies to embrace differences and help them work successfully across increasingly diverse business cultures.

At this stage we would like to present a few practical examples from a work place [22] and comment on them:

When making business abroad or having negotiations with a member of a different culture at his/her place there might be some of the following situations very likely to happen.

A

You meet a Spanish business colleague you haven't seen for ages who wants to stop and chat, but you're running late for an appointment. Do you stay or do you make your excuses and go?

B

A British salesman is giving you a demonstration of a new office product. He seems to like telling a lot of jokes. Do you join in the joke-telling or wait until he gets to the point?

C

You are having a pre-negotiation coffee at a potential client's headquarters in Bonn. Do you mingle with the opposing team or stick with your own people?

D

Your new American boss organizes a weekend barbecue. You find yourself amongst a lot of people you've never met. Do you join in the fun or slip away quietly?

E

A Finnish colleague invites you to conduct the final stages of an important meeting in the sauna. Do you accept or politely decline?

Here we present some comments on the issues above [23]:

A

Business people from Latin and Arab countries tend to have a more flexible, "polychronic" attitude to time than their "monochronic" North American and North European counterparts - for them time is money. Their "high-context" culture also places greater emphasis on personal relationships than "low-context" Northerners do. The message for us is not to be too busy for Brazilians or Italians and don't mess up Americans' tight schedules.

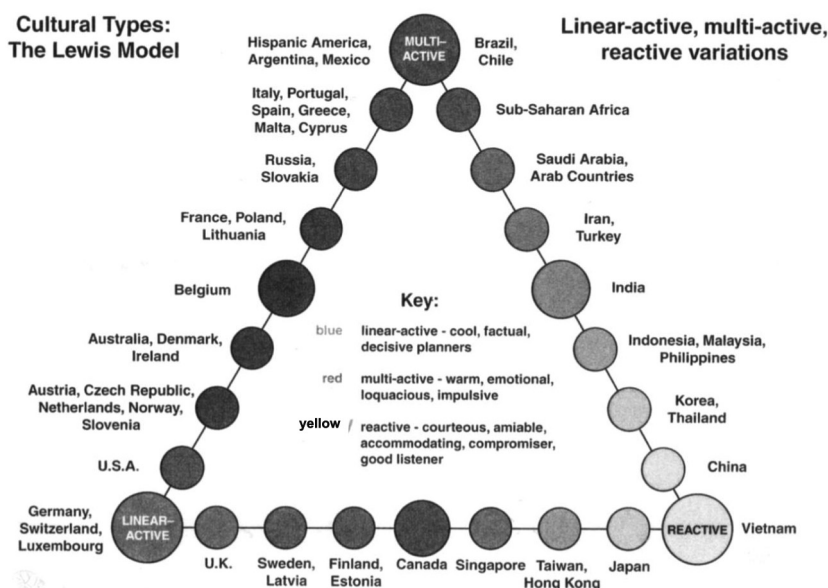


Fig. 1 LMR model by Richard Lewis [20]

Comparisons

Diane Rosseau, France

Linear-active	Multi-active	Reactive
talks half the time	talks most of the time	listens most of the time
plans ahead step by step	plans grand outline only	plans with general principles
polite but direct	emotional	polite and indirect
uses official channels	seeks out top or key person	uses connections
partly hides feelings	shows feelings	hides feelings
does one thing at a time	does several things at once	reacts to partners actions
dislikes losing face	has good excuses	must not lose face
job-oriented	people-oriented	relationship oriented
confronts logically	confronts emotionally	never confronts
rarely interrupts	often interrupts	does not interrupt
puts truth before diplomacy	has a flexible truth	puts diplomacy before truth
sometimes impatient	impatient	patient
limited body language	unlimited body language	subtle body language
uses mainly facts	puts feelings before facts	statements are promises
separates the social and professional	mixes the social and professional	connects the social and professional

L-M-R Rating

Fig. 2 Cultural comparisons [21]

B

A good sense of *humor* is an admired quality in many cultures – mainly among the British, Americans and in Latin countries even of the type of humor can vary from wordplays to sarcasm, etc. In other cultures, however – particularly Germanic ones – humor is not considered appropriate in a business context. One should not to be a comedian with the British, but always smile at their attempts at humor. With Germans or Swiss, it is better to leave the jokes for the bar after the meeting.

C

The amount of socializing we do prior to and during a *negotiation* depends both on your own and the opposite team's negotiation styles and the place where the negotiation is held. In Japan, for example, the negotiation process is long and relationship/confidence building plays an important part. The same is true of the Middle East. In the USA things move faster and their negotiating style tends to be more informal and sometimes unfriendly. In Germany there may be little time for small talk. Following the opponents' lead helps, but we should do all to create rapport.

D

Mixing with colleagues out of work-hours is an integral part of business in America where many companies are run like sports teams with the boss as captain and/or coach. Elsewhere, there may be a strong dividing line between work and home. The message is: In social situations simply be yourself, do not do anything that offends you or that may offend your hosts.

E

Different people have different ideas about an appropriate *place to do business*. For some, talking about golf all morning at the office and business all afternoon on the golf course is quite normal. Others do more business in bars than boardrooms. But these days people are more culturally aware and do not usually expect for-

eigners to observe their own business customs. The message to the question sounds: A polite refusal to go to a Finish sauna or Spanish bullfight will not usually offend.

In our thinking on cultural understanding we would finally like to stress and lean on the ways Silvia Schroll Machl [24] suggests for a better understanding among cultures:

Step 1 It is very necessary to get to know and get in touch with a foreign culture but as well to know and respect ones own culture,
Step 2 It is crucial to be aware and respect the differences in cultures,

Step 3 It is recommended to make a step forward towards general understanding but not in a way that the participant will have to or will be forced to lose their own identity.

4. Conclusion

Globalization, internationalization, cooperation, new management methods and trends are interesting areas for discussion. We have to bear in mind that one should not be judging whether other ways of doing are right or wrong, but instead be aware of the differences, and not see his/her own culture and his/her way of doing as the only one which is good.

Categories such as respect, understanding, genuine interest in members of other cultures, as well as attempts to be open-minded, adaptable and sensitive towards them, are the paths to be followed. We are convinced that these principles do not apply only for "doing business abroad" but what is more they help to promote the *win-win strategy* in many areas of life.

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Marek Hampł *

PRESIDENTIAL DOCTRINES AND STRATEGIES OF AMERICAN FOREIGN POLICY FROM 1947 TO 1965

This paper analyzes the most important doctrinal statements of American foreign policy from 1947 to 1965. Attention will be primarily focused on The Truman Doctrine, the writings by George F. Kennan, The Eisenhower Doctrine and the Johnson Doctrine. These statements of US foreign policy constituted broader strategy of containment of Communism during the first two decades of the Cold War. I shall argue that these declared doctrines and strategies provided theoretical background for containment of the Soviet influence on a global scale. Also, the doctrines and strategies provided basis for active involvement of the United States in the regions where there was an imminent danger of Communist expansion.

Key words: Containment, Doctrine, The Cold War, The United States of America.

1. Introduction

No nation in modern history has relied on doctrines or foreign policy statements that defined its stance towards the outer world as the most powerful state in the international system – the USA. American doctrinal thought after the Second World War to a great degree guided the course of foreign affairs in the USA as well as in the world.

This paper concentrates on the analysis of main political-military doctrines of administrations of American presidents from the end of the 1940's, throughout the 1950's and the 1960's that formed the attitude of the United States towards strategic areas of interests from its view. The Truman doctrine, the writings by George F. Kennan, the strategy of "containment" of Communism, the Eisenhower doctrine, and the Johnson doctrine will be of primary importance as they shaped the stance of particular US administrations to the international politics and mainly to containing of influence of the Soviet Union.

2. Some notes on the notion of "doctrine"

C. V. Crabb [1, p. 11] defines doctrine of foreign policy in the American perception as "a statement of general principles. In nearly every case its issuance was precipitated by a foreign crisis or a specific set of circumstances abroad to which the United States was required to respond."

A doctrine of foreign policy can also be viewed as an official conception of using the state's power in the international sphere. Therefore, such a doctrine constitutes a basis for adopting con-

ceptions of particular aspects of power, for the strategy of diplomatic activity, political-military strategies and also for strategy of propaganda.

R. E. Osgood [2, p. 4] attributes to presidential doctrines of foreign policy the "central role in U.S. foreign policy."

3. American doctrinal thought before the enunciation of the Truman Doctrine

Since the first half of the nineteenth century, the United States has had a tendency to embody main elements of its foreign policy in diplomatic doctrines. The dominating principle that was common for all presidential doctrines before the Truman Doctrine was isolationism which reflected American attitude mainly to Europe. The United States strongly refused foreign interference within its affairs. The isolationist stance was reflected mainly in the Monroe Doctrine and also in The Monroe Doctrine Corollary.

4. The Monroe Doctrine

The defining pronouncement of the refusal was the Monroe Doctrine, enunciated by President James Monroe on December 2, 1823. This doctrine was perceived as a set of principles that later came to define American isolationist policy towards European powers. The enunciation of the Monroe Doctrine initiated a new period of relationship towards Europe. The United States, that was weaker at that time and did not have the status of superpower, made use of the situation in Europe, however, in a way that was rather ambivalent. On the one hand, the USA formulated a require-

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ment for European powers not to intervene within the affairs of Latin America, but on the other, it claimed a dominant status in the whole Western hemisphere. The United States expanded into regions where there was a power vacuum and to regions without influence of European powers.

5. The Roosevelt Corollary to the Monroe Doctrine

The Roosevelt Corollary is considered as an extension of the Monroe Doctrine. This corollary was declared by President Theodore Roosevelt on December 6, 1904. Roosevelt's speech was directed to the region of the Caribbean that was experiencing a period of political instability, upheaval and the rule of dictatorship regimes. These countries were indebted to European creditors. As a result, there was a danger of intervention from Europe because creditors intended to recover the debts. However, this was considered unacceptable by the United States. Roosevelt [3] declared:

"Chronic wrongdoing, or an impotence which results in a general loosening of the ties of civilized society, may in America, as elsewhere, ultimately require interventions by some civilized nations, and in the Western Hemisphere the adherence of the United States to the Monroe Doctrine may force the United States, however reluctantly, in flagrant cases of such wrongdoing or impotence, to the exercise of an international police power."

As it can be seen from this declaration, President Roosevelt assured Europe that the Western Hemisphere was the sphere of influence that could not be attacked by any European power, which marked the evolution of the Monroe Doctrine. The Roosevelt corollary was significant in that it made the USA intervene on about sixty occasions in Latin America. This corollary had only regional character, because it was mainly the smaller countries of the Caribbean and Central America in which it intervened.

6. The Strategy of Containment of Communism

In 1947, The Soviet Union, having the status of the only power that could challenge the United States, was perceived as the greatest threat to international security and also to American interests in the post-World War II world. Thus, a requirement emerged to contain Soviet expansionism and a system that was based on different set of economic and social values. The strategy whose purpose was to execute this came to be known as "containment." For successful implementation of this strategy, the United States had to support its vulnerable allies and friendly states with a variety of programs and to assist them in their modernization. All this was aimed to forbid the Soviet Union the position of the status of the world hegemon. J. L. Gaddis [4, p. 4] characterizes the strategy of containment as follows:

"Containment is the term generally used to characterize American policy toward the Soviet Union during the postwar era, and can

be seen as a series of attempts to deal with the consequences of World War II. The idea has been to prevent The Soviet Union from using the power and position it won as a result of that conflict."

M. P. Leffler and D.S. Painter [5, p. 24] perceive the strategy of containment in terms of propagation of economic benefits. In their view the strategy of containment was "long-term American effort to effectuate a liberal capitalist world order that would be responsive to American economic needs and receptive to the dissemination of American ideas, values, and institutions."

However, there was also a lack of clarity about the content of the policy of containment of Communism that led to different perceptions among American scholars. As argued by conservative thinkers R. Strausz-Hupé and S. T. Possony [6, p. 679]:

"The concept of containment was never translated into a set of understandable, concrete, and workable propositions. The partisans of containment have yet to explain what they propose to do in order to halt or balance the rapid growth of the Soviet power machine or how, under the threat of atomic war, a policy of defensive and passive coexistence can preserve democracy and safeguard what Mr. Acheson called the very existence of all civilization ... and the safety of the free world."

The strategy of containment was officially formulated several times, although in rather general terms and quite vaguely. The attempts at the formulation of the containment strategy can be considered as the most important: The Truman Doctrine, the article "The Sources of Soviet Conduct" by George F. Kennan and "The Long Telegram" also by G. F. Kennan (1946). In addition to these statements, the memorandum of National Security Council NSC-68, is also seen as an important part of the containment strategy.

7. The Truman Doctrine

There are no doubts about the official character of the presidential statement from March 12th, 1947 in which the basic principles of the Truman Doctrine were formulated. This speech delivered by the president Harry S. Truman reasoned the willingness of his administration to provide support for the governments of Greece and Turkey. Similarly to the Monroe Doctrine, the Truman Doctrine was enunciated as a response to the immediate threat that the United States faced from abroad. This threat was constituted by the alleged Soviet interventionism in Greece and in Turkey.

Truman was convinced that international politics was dominated by a clash between two dissimilar systems of values. He stated that nations of the world were compelled to choose between alternative ways of life that were represented by the United States and the Soviet Union.

The crucial part of Truman's statement was:

"This is no more than a frank recognition that totalitarian regimes imposed on free peoples, by direct or indirect aggression, undermine

the foundations of international peace and hence the security of the United States." [7, § 30]

By this, Truman presented the essence of his speech: the security of the USA and peace in the world were mutually interconnected. The United States was about to take over the status of Great Britain as the main player in the Near East and also around the world. Thus, he indirectly suggested that the United States should assume the role of the world's policeman. When responding to the threat of totalitarianism, Truman stated that the United States had to respond firmly, but primarily through the means of economic assistance. He stressed that the situation in the Near East was serious, and that if Greece and Turkey fell, it would cause confusion and disorder in the entire Middle East region. Also, the fall of these countries would have had a profound effect on other countries in Europe.

7. Analysis of the article by George F. Kennan – 'The Sources of Soviet Conduct'

There were two seminal texts by American diplomat George F. Kennan published in 1946 and in 1947 that influenced the attitude of the Truman administration and stirred discussion about the nature of the Soviet Union. Both articles summarized the features of Soviet foreign policy, its main motives and ambitions.

George F. Kennan was a distinguished diplomat with realistic views on the Soviet Union and is considered as the "architect" of the strategy of containment. The two texts that he rendered provided a new direction for American foreign policy in the post World War II era. "The Long Telegram" (1946) that was sent from the embassy in Moscow proposed revolutionary viewpoints that influenced American foreign policy in the decades to follow. His first article, "The Sources of Soviet Conduct" was published under pseudonym Mr. X and is often viewed as a theoretical reasoning of the policy of containment.

In the article "The Sources of Soviet Conduct", G. F. Kennan depicted the picture of an aggressive Soviet Union driven by Communist ideology that had to be faced. The term "containment" was used for the first time in this article. The article was published in Foreign Affairs in July 1947. In this article, it was declared that "the main element of any U.S. policy toward the Soviet Union must be that of long-term, patient but firm and vigilant containment of Russian expansive tendencies." [8, § 29] G. F. Kennan presupposes that these tendencies are an outgrowth of Marxist-Leninist ideology as well as of circumstances that are associated with historical development of Russia. According to him, it is possible to expect "the Soviet pressure against the free institutions of the Western world" [9, Kreis, 2000, § 30] in the near future.

G. F. Kennan does not recommend any confidential and reliable relationship with the Soviet Union. In his view, it is necessary to face the Soviet efforts by "adroit and vigilant application of counter-force at a series of constantly shifting geographical and political points, corresponding to the shifts and manoeuvres of

Soviet policy" [10, § 30]. The purpose of this American counter-pressure is not only to prevent the Soviet Union from further expansion, but according to G. F. Kennan,

"it is entirely possible for the United States to influence by its actions the internal developments, both within Russia and throughout the international Communist movement by which Russian policy is largely determined." [11, § 30]

The whole concept of containment that G. F. Kennan outlined was viewed as a "strategic monstrosity" by W. Lippmann [12, p. 18]. W. Lippmann also criticized the notion of unalterable counter-force that was proposed by G. F. Kennan.

Furthermore, W. Lippmann [13, p. 21] observed that this force could not be put together only by American troops and American military potential. Thus, he noted that it had to be "composed of Chinese, Afghans, Iranians, Turks, Kurds, Arabs, Greeks, Italians, of anti-Soviet Poles, Czechoslovaks, Bulgarians, Yugoslavs, Albanians, Hungarians, Finns and Germans" [14, p. 21].

In addition to this measure, W. Lippmann [15, p. 21] also proposed "supporting a heterogeneous array of satellites, clients, dependents and puppets." But he came to the conclusion that these instruments of the policy of containment would paradoxically result into "a coalition of disorganized, disunited, feeble or disorderly nations, tribes and factions around the perimeter of the Soviet Union" [16, p. 21]. Thus, he called for formation of modern states that could challenge the Soviet Union. Finally, he criticized G. F. Kennan's perception of the function of diplomacy: "For a diplomat to think that rival and unfriendly powers cannot be brought to a settlement is to forget what diplomacy is about." [17, p. 21]

However, this important statement by G. F. Kennan defined the strategy of containment as the basic American principle towards the Soviet Union. It can be also interpreted as an appeal to build-up military bases along the borders of the Soviet Union. And finally, it also conveyed an intellectual reasoning of the containment itself and introduced this strategy to public focus.

G. F. Kennan's main contribution lies in the fact that he formulated the requirement for transition from isolationistic ideas about "Fortress America" to interventional dreams about "Pax Americana". The former concept was associated with right-wing neo-isolationists and presupposed that the United States could protect its own security although there were political turbulences abroad.

A different perception and criticism of the strategy of containment was proposed by W. Lippmann who had formulated the conception of Soviet-American relations already during the World War II. His views were different to those of G. F. Kennan. W. Lippmann [18, p. 95] assumes that the history of relations between Russia and the

United States proved that it was not ideology but national interest that was crucial for the line of foreign policy. This resulted

from the fact that Russia and the United States always took opposing stances in regard to particular ideology, but at the same time they considered each other as potential allies behind the lines of a potential enemy. [19, p. 95]

W. Lippmann [20, p. 29] strongly condemns the policy of containment proposed by G. F. Kennan by claiming:

"my objection, then, to the policy of containment is not that it seeks to confront the Soviet power with American power, but that the policy is misconceived, and must result in a misuse of American power. For as I have sought to show, it commits this country to a struggle which has for its objective nothing more substantial than the hope that in ten or fifteen years the Soviet power will, as the result of long frustration, 'break up' or 'mellow'."

W. Lippmann [21, p. 28] also held the opinion that it was necessary to confront the Soviet Union with American power, but he assumed that "a policy of containment does not contain", and that "measures of counterforce are doomed to be too late and too little."

8. The stance of American conservatives towards the strategy of containment of communism

The conservatives and isolationists in the USA perceived the policy of containment as being too defensive for the needs of the United States. In their view, the whole strategy did not grasp the essence of the Soviet power and the fundamental principles of Soviet system. Therefore, they thought that it was aimless. They did not perceive as a unified concept, because it preferred containing Communism mainly in Europe and actually led to the "loss" of China in 1949. This stance is supported by R. Strausz-Hupé and S.T. Possony [22, p. 670] who assume that "it is unnecessary to stress the fact that the stakes in China were far greater than those in Greece or even Turkey", and that "the United States allocated to individual European countries sums that were much larger than total of Chiang's share" who was directly involved in the fight against Communism. Therefore, R. Strausz-Hupé and S. T. Possony [23, p. 678] presuppose that "the policy of containment and coexistence leaves the initiative in the Soviet hands." Similar standpoint can be found in J. Burnham [24, p. 30] who is of opinion that "a defensive policy – and containment is a variant of the defensive – can never win."

We can conclude that American conservatives paradoxically saw the strategy of containment as a mere reaction to Soviet initiatives or as a formula to overall Soviet victory. Moreover, containment was perceived as a variation of defensiveness that could be hardly applicable worldwide.

9. The Eisenhower Doctrine

The Eisenhower Doctrine is in its essence similar to the Truman Doctrine, however, the main difference between them lies in the fact that the Eisenhower doctrine led to military involvement of

USA in the Middle East, whereas the Truman Doctrine got the US involved in the Korean War. Nevertheless, this doctrine bears similarity to the Truman Doctrine and it can be said that it is actually an extension of the Truman Doctrine and of the containment strategy, however, specifically designed for the region of the Middle East.

President Dwight David Eisenhower enunciated his doctrine on January 5, 1957, before a joint session of the Congress, at the beginning of his fifth year in the office.

Eisenhower in his speech stated the chief principles of American foreign policy after the defeat of intervention of Great Britain and France in the Suez Crisis. Britain and France wanted by joint forces to overthrow Egypt's nationalization of the Suez Canal, however, they were not successful.

The Suez Crisis of 1956 significantly changed the political map of the Middle East and accelerated the rise of Arab nationalism in the region. The result of the Suez Crisis set the stage for the framework of the Eisenhower Doctrine. Also, the Soviet Union for a brief period of time considered a possibility of intervention on the Egypt's side in this crisis, which only intensified the US efforts to secure this strategic region. Eisenhower asked the Congress for 200 million dollars a year for three years for help to nations of the Middle East. The purpose of this aid was to secure "any nation or group of nations in the general area of the Middle East the development of economic strength dedicated to the maintenance of national independence." [25, §17]

Apart from economic and military assistance to pro-American regimes, Eisenhower in his speech demanded to protect "the territorial integrity and political independence of such nations, requesting such aid, against covert armed aggression from any nation controlled by International Communism." [26, §19] Thus, Eisenhower similarly to Truman indirectly suggested taking over the role of the world leader that had been occupied by the British Empire up to then. Formulations about an effort to avoid other conflicts similar to the Korean War were accompanied by the program that denounced the conceptions of containment and rather adhered to the firm conservative conceptions of 'liberation'.

The Eisenhower administration feared that the power vacuum created by withdrawal of Great Britain from the area would be filled by Communism. As argued by R. Takeyh [27, p. 110] filling this vacuum could give Russia an "opportunity to improve its position in an area having vital resources and strategic location." This also caused anxiety of Washington about the security in the Middle East.

In reference to the Soviet Union, Eisenhower presented Communist aggression as being imminent in the region of the Middle East. He named two relevant reasons why the United States should engage in the area of the Middle East. International Communism, according to Eisenhower, had always aspirations to dominate the region of the Middle East. The second reason that was provided by Eisenhower concerned the alleged expansiveness of the Soviet

regime that intended to gain control of the Middle East area. Eisenhower highlighted the cases of Estonia, Latvia and Lithuania that were “forcibly incorporated into the Soviet Union” [28, § 8] as well as Soviet control of the satellite nations of Eastern Europe as a proof of his claim about expansiveness of the Soviet regime.

The secondary aim of the doctrine was reduction of the rising influence of Egypt that was about to take the role of the leader of Arab world. Egyptian president Gamal Abdul Nasser was considered as an embodiment of Arab nationalism. Also, as put by R. Takeyh [29, p. 142], Nasser had positive attitude to the Soviet Union and was thought to be an extension of Soviet influence in the Middle East. Nasser was the most popular leader in Arab world and an “undisputed embodiment of the region’s historical quest for self-determination.” A broad movement that was known as “Nasserism” was perceived by the officials in the Eisenhower administration as the next thing to Communism. By depicting Nasser as a collaborator with the Soviet Union, the United States could legitimize its intended measures and policy. Nasser also strongly condemned Western imperialism, which worried Washington.

W. Lippmann (1947) observed that purpose of the eloquence of the doctrine was actually to give the Secretary of State John Foster Dulles a free hand in his actions. The closest ally of the United States – The British, had a different perception of the Soviet threat in the Middle East. They did not see any imminent threat from the Soviet side and wondered whether a new arms race was starting in the Middle East. The rhetoric of the doctrine was even perceived in Europe as a final step towards a kind of the hegemony of the United States.

The Eisenhower doctrine undoubtedly presented an attempt to gain allies from the area of the Middle East into the sphere of influence of the USA in the global struggle against the Soviet Union. It is undeniable that the Eisenhower administration also accepted the logic of the strategy of containment.

However, as a part of the containment policy, the Eisenhower Doctrine also had certain weaknesses. It is questionable whether the doctrine prevented Soviet influence from penetrating into the region of the Middle East. Also, the basic premise on which the doctrine was built-up, i.e., filling the power vacuum in the Middle East was rather offensive to Arabs and partly contributed to polarization of the region.

11. The Johnson Doctrine

There are several foreign-political doctrines that are associated with the presidency of Lyndon B. Johnson. C. V. Crabb [30, p. 4] suggests that there were actually two Johnson Doctrines enunciated: a declaration made by Johnson in August 1964 about the necessity to “take all necessary measures in support of freedom and in defence of peace in South Asia” [31, p. 4]. This doctrine came to be known as the Gulf of Tonkin Resolution which legit-

imized American military involvement in Vietnam. Similarly to all doctrines discussed so far, this doctrine was also enunciated as a reaction to a perceived crisis abroad.

When American naval units were attacked in the Gulf of Tonkin on August 4, 1964, President Johnson said that the United States was prepared to

“take all necessary steps, including the use of armed force, to assist any member of protocol member of the Southeast Asia Collective Defense Treaty requesting assistance in defense of its freedom.” [32, p. 19]

Johnson asked the Congress to affirm that “all such attacks will be met.” [33, § 12]. Finally, the Congress passed the Gulf of Tonkin Resolution which stated that “the Congress approves and supports the determination of the President, as Commander in Chief, to take all necessary measures to repel any armed attack against the forces of the United States” [34, §15].

The text of the Gulf of Tonkin Resolution stated that “Congress approves and supports” efforts executed by President to “take all necessary measures designed to repel attacks upon American military units. Also, the stress was placed “to prevent further aggression.” [35, § 15].

As it can be seen from the rhetoric of the doctrine, the main purpose of the Johnson Doctrine was to present a united American stance towards the world. The doctrine was designed to have a deterrent effect on North Vietnam and also on other Communist states supporting North Vietnam. Also, the doctrine was intended to highlight the importance of American commitments in Southeast Asia that were defined in the Southeast Asia Collective Defense Treaty that was signed in February 1955. According to Johnson, this treaty “obligates the United States and other members to act in accordance with their constitutional processes to meet Communist aggression.”

11. Conclusion

From the analysis above, we can conclude that the strategy of containment of Communism became the crucial element of American foreign policy and diplomacy during the early Cold War period. As noted by P. Seabury [36, p. 39], “it is nevertheless true that one theory—that of containment served a whole generation of American decision-makers as the foundation of our foreign policy.” Indeed, this strategy provided a theoretical framework for the American position in the Cold War. On the other hand, the Soviet Union did not accept American view of the containment strategy at all.

Containment of Soviet power and influence all over the world was considered as the most important aim of US foreign policy because the Soviet Union posed the greatest danger to US interests and security although the United States accepted the existence of the Soviet Union as a fact. According to the containment doctrine, the Soviet Union was seen as the chief enemy of world order.

Nevertheless, as it can be seen from the analysis of the rhetoric of the presidential doctrines and documents that constituted the strategy of containment, this strategy became the principal objective of the United States and the presidential doctrines of that time were in their essence designed to stop Soviet expansion in the regions delineated by these doctrines.

At the end of the Second World War, the United States and the Soviet Union emerged as the two major powers that determined the situation in the international system [37]. During the following period of the Cold War, these superpowers competed in many areas, such as military or economic. As discussed in this article, the notion of containment of Communism provided the basic American embodiment of relationship towards the Soviet Union in the early Cold War period. For most of the Cold War era, these two superpowers defined themselves as the most significant obstacle to the hegemony in the world for each other.

The Soviet Union with its allies and faithful agents tried to unite the Socialist countries – this was to be the means of how to

stop capitalism. On the other hand, the United States of America, with its presidential and containment doctrines that were designed to confront the Soviet Union as well as with defense alliances and means of economic assistance (e.g., NATO, The Marshall Plan) was committed to confront the Communist movement.

American concept of security that stemmed mainly from presidential doctrines and strategies of National Security was during the Cold War active and in a certain sense missionary for the United States. This concept expanded in terms of geography from the end of World War II together with the growing global activity of the United States and helped to execute broader global goals. At the same time, it was mainly designed to confront the interests of the main rival – the Soviet Union. Beginning with the Truman Doctrine, continuing with the Eisenhower Doctrine and concluding with The Johnson Doctrines, each and every doctrinal statement enunciated in the USA in the first two decades of the Cold War also involved a strong assertion to the principles of ideology that were accepted by the main American political streams.

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Zuzana Zilova *

THE LANGUAGE GAME AS THE CONSTITUTIVE COMPONENT OF POSTMODERN PLURALITY WITH REGARD TO MORAL AND INTELLECTUAL PREFERENCES OF CONTEMPORARY SOCIETY

The contribution deals with the analysis of postmodern plurality by applying the term a "language game" to the postmodern condition. It makes use of the word that originally derives from Wittgenstein's analytic philosophy and was supplemented with Lyotard's conception that sees the society as the multi-central body consisting of many independent areas. It tries to emphasise the advantages of the situation such as freedom of expressions, wide range of options to choose from, creativity, but faces up disorganization. It examines the possibility of development and the role of knowledge in the situation of plurality.

Key words: language game, plurality, autonomy, development, knowledge

1. The origin of the term and its introduction to philosophy

The intellectual activities in the Period of Postmodernism concentrate on two main issues: either they analyze the role of language that became the new tool how to interpret, proceed and form reality; or they notice the idea of plurality as the principal constitutive element expressing not only the new structure of society but also the model of morality and behaviour. Postmodernism is typical of the raising interest in crossing linguistic and ethical issues, it witnesses the expansion of subjects, themes, terms, methods that used to be specific for linguistics into the other areas like ethics, culture, values, knowledge, justice.

Similarly, the term a "language game" first appeared in the field of philosophy concerned with the role of language in epistemology. The subject was brought up by Ludwig Wittgenstein in his work "Philosophical Investigations" and was connected to everyday life and ordinary language. Wittgenstein named "the language game" each single human activity, for example: giving orders, and obeying them; making up a story, and reading it; forming and testing a hypothesis; making a joke, telling it; asking, thanking, cursing, greeting, praying [1]. As he states, confusion and chaotic structure of ordinary activities is not the fact that should be eliminated, but it is the source of linguistic riches, because it necessarily involves the use of specific forms of language that consist of different rules, signs, patterns. Thus each social group plays its own language game: students, lawyers, scientists, workers, musicians, teenagers and their speaking serves to their needs and interests. Naturally, all members are supposed to be aware of the rules if they want to take part and play the game successfully.

The features of variability, autonomy, multiplicity were made use of by Jean – François Lyotard. He switched over the meaning of "the language game" from linguistic issues to ethical and behavioural matters and applied it to picture the contradiction between the homogenous society that controlled human intellectual activities until Modernism and the postmodern phenomenon of the open society. The language game became a crucial word that expresses its plurality, multiculturalism, globalization, anti-centralism.

Lyotard starts the explanation with the examination of various historical periods. He says that there used to be crucial historical periods that represented, explained and legitimized social, religious or moral understanding of the world. These periods were considered to be the principal explanative ideas of an appropriate era and were typically characterized by some forms of transcendent or universal truth. Lyotard called them "the Grand narratives". They provided "the narrative knowledge", which was the knowledge of story-telling (myths, customs, religion, values) that not only clarified, but also justified everything within the system. The Grand narratives were based on the principle of wholeness, totality, inner coherence and stood for the undoubted concepts [2].

The postmodern society expresses considerable suspicion of such exclusive forms of foundation. The origin of this feeling can be traced in more sources: Western civilization that used to be proud of its Christian and Greek ideals of humanity capitulated from its central role in spreading the truth after it had admitted such events like Holocaust or Hiroshima. The disappointment has hit the Euro-American region encouraged by the expansion of other cultures, religions, values that contradict or subvert its original

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heritage. The Grand narratives have become bankrupt. This resulted into "...the disintegration of social aggregates into a mass of individual atoms thrown into the absurdity of Brownian motion" [2, §41]. The concept of society based on the plurality of fragmented areas (language games) appeared.

2. Plurality of language games as the model of postmodern condition

The most common concept that is connected to the theory of language games is its application to the situation of postmodern plurality with its main features: fragmentation, multiplicity, independence, autonomy, incommensurability. Using them Lyotard describes the society consisting of abundance of micronarratives (as the opposite to the former period of the Grand narratives) each one with its own criteria, goals, methods, responsibilities, moral values. There is no authority that would approve one game to provide universal truth or ultimate order. This concept is supported by the strong individualism with the indisputable right to choose own concept of life. In the situation of globalization and multiculturalism one game does not seem to be enough to capture the diversity of the world. Similarly, there are to be many ways how to organize one's behaviour and role in society, more concepts to develop personal, intellectual and creative potential. From this point of view, "self" represents the minimal space with its own autonomy. It is the language game itself that proclaims its uniqueness and sovereignty.

There are different attitudes to the postmodern condition. Advocates praise personal freedom, tolerance and respect to various concepts of life; opponents criticize its chaotic structure, vagueness, moral indifference, superficial approach to values and liken the postmodern man to a "sandy being" that can easily adapt personality to any kind of situation taking only benefits into consideration. In fact, there is no problem to move from one language game to another, change an opinion according to particular circumstances. Society lacks, and does not insist on personal attitude. Toughness and persistency are features of obsolete rigidity. The human nature should be flexible, adaptable to changeover. Not surprisingly, this is what postmodern thinkers warn against. Wolfgang Iser reminds us of the important difference in understanding the postmodern plurality. He differentiates [3]:

- a) the genuine plurality typical of accuracy that tries to support dissimilarities, argues for preservation of originality of each language game, refuses mixing criteria and moving rules from one concept to another, does not compromise due to getting benefits. It is the counterpart of anarchy that seems to be the common and popular but completely improper understanding of the idea of plurality.
- b) plurality as the chaotic organization of society without distinct centres and boundaries where rules are mixing up without any critical thinking. It is the vague and superficial blending of ideas in the name of fashion, needs, profit, moral and intellectual indolence. Unfortunately, this view prevails and affects the behaviour of the postmodern man who is neither an autonomous subject nor a decision-maker but more a point of

intersection, where different language games try to use his weak personality to fight for power.

There is also another paradox in the structure of postmodern plurality. Although said to be multicultural and open, it tends to prefer scientific and technological approach to the world and disqualifies the other concepts e.g.: ethics, religion, legends. Although the postmodern period is typical for searching spiritual dimension and witnesses the boom of religious and mythological imagination, everyday practice is determined by utility and pragmatics of language games that provide convenient and comfortable life. In this understanding spirituality stands for luxurious experience reserved for the special occasions like Sunday service or Christmas time and it is far more for amusement than for serious interest. However, the strong evidence that people long for transcendent sphere can be seen in popularity of this genre in literature: The Da Vinci Code, The Twilight Saga, Harry Potter. The supernatural pictured in these books forms the opposition to inhuman scientific explanation of the world.

Obviously, it is natural that each language game tries to protect its integrity from outer intrusion by questioning those ones that could disturb its unity. Nevertheless, the language game of science is really pervasive and suppresses the other concepts. To understand this, we should explain the nature of knowledge in two main historical concepts: the role of knowledge in the periods of the Grand narratives and its modification due to the plurality of language games. We make use of Lyotard's view on knowledge and his division [2]:

- a) narrative knowledge – typical for traditional societies, cultures, religions, based on story-telling, rituals, myths, parables, that provided timeless order and unchallenged support to human behaviour. Its affirmation was included within the system, usually on ontological basis represented by some kind of spiritual dimension like God, essence, Logos or secret law hidden behind the material world as seen in the Grand narratives (Hegelian, Marxist philosophy) as well as in the great religious concepts - Christianity, Islam, Buddhism.
- b) scientific knowledge – the concept of contemporary society based on quantity of language games that lacks metaphysical foundation and asks for affirmation of its statements and achievements in other way. The justifying derives from the set of conditions that are agreed on in advance, and have to be fulfilled in the process of considering their validity or falsehood. This means that language games are separate systems in which meanings are produced and rules for their calculation are created due to mutual agreement.

As we have stated, Postmodernism refuses the exclusivity of the narrative knowledge as obsolete, not meeting targets of the pluralistic society. Unfortunately, this openness is only the illusion. The postmodern society tends to privilege the language game of science and its criteria stand nearly for absolute obligations. To analyze this paradox it is useful to examine the role of development and knowledge in Christian and Greek roots that provided the basis for Western civilization for centuries and their interaction with the postmodern tendency for deconstruction of all traditions.

3. Two interpretation of the development of knowledge

Although the development of human knowledge was primarily understood as the spiritual movement governed by a search for happiness and a desire for eternal life, since the 16th century the scientific sphere has been trying to absolutize its criteria: experimentation; observable, empirical evidence; accuracy, objectivity, utility, repeatability. It has been trying to eliminate other concepts. There are more observations about this predominance:

The first one is anti-essentialism that claims that there is no ontological basis for universal validity of the truth, the good or values. They are not ready-made or existing in a form of eternal ideas while people are to discover them. To put it into practice – all scientific theories and definitions are temporary achievements and as such subject to modification. They acquire the role of mere social conceptions that depend on interests, needs, expectations, outcomes of a particular period [4]. If a scientific concept stops giving satisfaction it will be replaced. It is a constant competition for power similar to the idea of Darwin's natural selection.

The other reason can be seen in the way how the term "development" is understood. The technical progress with its criteria of acceleration and utility is considered the most important category by which the quality of society is measured. There are two theories about this issue: either the development and knowledge are accumulated as regular, continuous and unanimous or they can be seen as periodic, discontinuous, conflictual [2]. Although Western civilization abandoned the ideal of Christianity, its interpretation of time is still alive. It presumes that time flows continually starting from the creation of the world described in the book of Genesis to its doom seen in Revelation. This obsession with continuity is present in thinking of postmodern man. However, the thinkers like Lyotard, Foucault or Derrida prefer the second theory and try to shatter any kind of conventional order the Western civilization was used to. In his famous work "The order of things" Michael Foucault states that any culture builds the set of controlling mechanism represented by habits, customs, values, particular scientific and technological approach. It forms a kind of language (or grid) imposed on reality, affirming or excluding all statements entering the system. He calls this organizing idea episteme (or dominant discourse). It is "the fundamental code of a culture governing its language, its schemas of perception, its exchanges, its techniques, its values, the hierarchy of its practices establish for every man, from the very first, the empirical orders which he will be dealing and within which he will be at home" [5, p. xxii]. In Foucault's opinion, it is illusive to think that human knowledge moves forward continually without any kind of interruptions, obstacles, digressions. Stating three important periods in human history – the Renaissance, the Classical age, the Modern period he reveals that there were at least two discontinuities in the development of Western culture. Foucault's and Lyotard's ideas presume that the reality is fragmented in both directions: horizontally – there is no possibility for human development to move forward in linear series, as well as vertically in a form of numerous language games with many centres existing in parallel. This statement can be supported by another postmodern thinker Paul K. Feyerabend who objects

any single prescriptive scientific method and advocates the idea of anarchism in development: "Knowledge is not a series of self consistent theories that converges towards an ideal view; it is not a gradual approach to the truth. It is rather an ever increasing ocean of mutually incompatible alternatives..." [6, p. 21]. He finds methodology, criteria, rules that Western civilization considers indisputable the violation of knowledge. He declares that the reduction of reality to the only conceptual model, that is restricted, isolated from others, destroys traditions and constitutes chimeras [7].

The consequences of this fact could be disturbing for the contemporary man. Postmodernism is said to be pretty proud of its plurality of language games and tolerance to various opinions, practices, life-styles. Nevertheless, it seems to be unacceptable to admit that progress cannot be understood as linear process for more language games provide more and often contradictory concepts. Naturally, plurality implicates the diffusion of power. Thus, the struggle of two strong desires worries the postmodern man: the first one is the request for tolerance and refusal of any absolute or limited concept of the world; the second derives from inevitable urge for stability that could guarantee the integrated system of knowledge. This need is so strong that it preserves the idea of linear development in the form of scientific knowledge and causes its supremacy over other language games. It creates the illusion of continual progress.

4. Supremacy of science and the status of knowledge within this concept

Besides the misleading desire for the model of continual growth there are, according to Lyotard, three other factors that determine science to be the dominant language game [2] [8]:

1. Criterion of performativity
2. Computerization of society
3. Merchantilization of knowledge

In his opinion, the postmodern society is controlled by four fields, each one of its own criterion that determines its activities, responsibilities, methods, goals [8]:

FIELD	CRITERION
Science	Best knowledge
Technology	Best efficiency (performativity)
Economy	Best wealth
State (body politic)	Best "living together"

These areas cooperate to boost the progress. However, the field of science and its criterion of efficiency (performativity) prevail and force other areas to adopt the same pattern. The reason for this is the strong connection between knowledge, power and needs of society: if the development is controlled by the ideas of materialism and consumerism, it is possible to approve the scientific

knowledge the only valid language game. In this situation, performativity became the dominant model for all human activities and prevents other language games (as non-productive) from being taken as serious partners.

The second factor we should take into account if talking about the dominant role of science, is the way of data-recording. Research, learning, gaining knowledge have something to do with communication, informatics, problems of encoding and decoding information, its storage and access to it. Computers are considerably changing the nature of understanding reality. It seems to be incredible that this development was predicted by Lyotard in 1987, when he anticipated that: "...anything in the constituted body of language that is not translatable in this way will be abandoned and that the direction of new research will be dictated by the possibility of its eventual results being translatable into computer language" [2, § 4]. Besides the other criteria (performativity, utility, observation), the necessity to acquire the status of computer data also works as the tool of power that excludes some information from being a part of knowledge stating them as non-scientific.

Another influential factor is the phenomenon of the affluent society with its main goal of fulfilling all needs by never-ending progress that enables to provide latest and more sophisticated stimulations. This understanding has changed the opinion of knowledge and caused, as Lyotard states, merchantilization of knowledge. Instead of its original function – to serve the truth to get revealed, or (at least) to recognize the truth, it became the consumer goods: "Knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorised in a new production" [2, § 5]. What is out of the category "demand and supply" cannot be the serious part of knowledge e.g. religious and mythical theories. Unless they become commodities in the form of best sellers or blockbusters, they represent only marginal alternatives to scientific concepts. Thus we can consider the triangle: knowledge, science and technology to be the impetus of postmodern civilization. They control all its areas from tiny problems of everyday life till sophisticated political decisions [10] and, despite the number of language games, create a potential for the new form of totality.

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Katarina Mackova – Andrea Gavlakova *

SCHOOL STRESS COPING STRATEGIES CHECKLIST

This paper deals with school stress and describes coping strategies used in load situations. Empirical research reveals what extent of stress pupils of elementary schools perceive as well as what coping strategies are most commonly utilised. Based on the findings we can conclude that the extent of the stress perceived by the sample group of school children is moderate and they resort to coping strategies such as "avoidant action" and "distracting action".

Key words: stress, stress in schools, coping strategies, CCSC questionnaire

1. Introduction

The word stress has become more frequent notion not only among experts but also in general public. We deal with stress on a daily basis at school, at work, even at active recreation, hence everywhere where performance, success and "perfection" are of crucial importance. Stress has become a natural part of life of adult individuals, however recently it has been affecting younger generations to a growing extent. A number of theoretical and practical findings enable us to assume that the most contributing factor generating stress in children is school. A profound research of "school stress" has been conducted in the last thirty years both in our country as well as abroad (Ayers, T.A., Sadler, I.N. 1996, Kyr-iacov 2001, Mares 2000, Koubekova 2000, Bratska 1992, 2004, Hanzlova, M. – Macek, P. 2008, Fickova, E. 2001, Sarmany – Schuller 1999, etc.)

School stress can be defined as a negative emotional experience, e.g. anxiety, anger, depression, frustration, resulting from certain aspects of learning. The term school stress refers to the type of stress induced at school, and hence distinction must be made from other sources of stress, e.g. fear for parents who continuously argue or a long-term impaired health condition etc. Nevertheless the stress that arises outside school that has a significant impact on a pupil's temper and behaviour at school but it must not be considered the cause of school stress. [14] School stress mostly results from concerns and worries due to school and demands laid by the school.

Manifested symptoms of stress are not only mental (neurotical symptoms, anxiety, tension, fear, aggressiveness), but also physical (enuresis, headache, stomachache, allergies, and various other indef-

inite symptoms). Immune system is also significantly affected by stress, which may lead to deteriorating health condition. [11]

School places high demands on the personality of a pupil, which then plays an important role in coping with stress. Coping with stress are exceptionally important skills for pupils. Discovering coping strategies can contribute to reducing stress in schools. Determining appropriate requirements and respecting abilities and interests of a child can help reduce and eliminate pressure.

Definition of the term "coping" is not unified in technical literature. The term "coping" has its origin in Greek "colaphus" (box on the ear). General meaning of the word refers to an effort to solve problems, handle conflicts or arguments. The English word coping implies an ability to deal with a difficult, almost unmanageable situation. [13]

Most frequently cited definition by R. S. Lazarus and S. Folkmanova (1984) describes coping as an ever-changing cognitive and behavioural effort of an individual to handle, tolerate or reduce demands that burden or even exceed their mental abilities. [12]

Several authors pointed out the differences between defence mechanisms and coping strategies. [12, p. 537] According to Erickson (1997), common features of defence and coping reactions are reducing stress and controlling emotions, dynamic nature; they are both potentially reversible and developable throughout people's lives and particular elements can be distinguished in them. However, they differ in certain aspects; defence reactions include implicit operations in contrast to coping reactions, they are activated intrapsychically, an individual is not aware of them; they are determined by personality features and are based on instinctive behav-

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our. They are not preceded by evaluation of the situation, they lead to automatic behaviour and are more difficult to observe. Coping is considered to be a personality feature or a behavioural style. [3]

2. Brief Overview of Copin Strategies Research

Much research has been carried out with the aim to discover most often used coping strategies. Amirkhan (1990) based his work on the presumption that despite a great number of existing and well-defined coping strategies their actual value does not correspond to the theoretical grounds and assumptions. Amirkhan made an attempt to bridge deductive approach (prefabricated taxonomies of coping behaviour categories) and inductive approach (elaborating response clusters constituting general categories based on the coping behaviour documentation) by studying conjunction between them. [16]

CSI scale (*Coping Strategy Indicator*, J. H. Amirkhan, 1990) was created on basis of a factor analysis in order to establish three factors corresponding to three fundamental methods. They are used as a primary source to cope with stressful experiences. The three strategies are listed below:

- *Instrumental strategy*, relates to problem directed approach
- *Seeking social support* relates to the basic human need for human contact through a process of actively turning to others for comfort, help and advice,
- *Avoidance strategy*, relates to both physical and psychological escape. [16] *KIDCOPE* scale (Spirito, 1988) identifies ten coping strategies:

Distraction, social withdrawal, cognitive restructuring, self-criticism, blaming others, problem solving, emotional regulation (positive and negative), wishful thinking, social support, and resignation.

Fickova, Ruisekova (2001) carried out research based on *KIDCOPE* scale. A sample of 1st and 3rd year grammar school students in Bratislava (aged 14 – 17) were used in their analysis to identify coping strategies in stressful situations.

The questionnaire verified presumed differences between boys and girls. Girls preferred problem solving, wishful thinking, social support, cognitive restructuring and boys gave preference to problem solving, cognitive restructuring, wishful thinking and self-criticism. Both male and female adolescents prefer problem solving but differ in seeking social support which rates ninth in boys. Blaming others and negative emotional regulation are the least frequently utilised strategies by both girls and boys. [9]

COPE, developed by C.S. Carver, M.F. Scheier and J. F. Weintraub (1989), is another type of a questionnaire comprising 60 items, 4 items for 15 coping strategies. It is based on the Lazarus's stress and coping model (Lazarus, 1966), self-regulation model (Carver, Scheier, 1985) and results of research presenting various levels of coping. The questionnaire is comprised of the following strategies:

Active coping, planning, suppression of competing activities, restraint coping, seeking social support for instrumental reasons,

seeking social support for emotional reasons, positive interpretation and growth, acceptance, turning to religion, focus on venting of emotions, denial, behavioral disengagement and mental disengagement.

E. Fickova (1992) described and elaborated Slovak version of *COPE* questionnaire. A sample of 242 1st and 3rd year grammar school students were studied in the analysis. The results showed that girls mostly resorted to seeking social support for emotional reasons, positive interpretation and growth, seeking social support for instrumental reasons and acceptance. Boys preferred positive interpretation and growth, planning, active coping and acceptance. Both sexes congruently tended not to resort to alcohol and drug abuse, behavioural disengagement, turning to religion and denial. The most significant and statistically considerable divergence regards social support for emotional reasons utilised by girls in the first place and by boys in the tenth place. [9]

CISS (*Coping Inventory for Stressful Situations*), elaborated by N. S. Endler and J. D. A. Parker (1990), is another coping strategies questionnaire comprised of 48 task oriented (efforts to change and solve problem situation), emotion oriented (efforts to reduce stress) and avoidance coping items. The analysis was executed by E. Fickova (1992). The results revealed only slightly higher coping indicators' values in girls. Task oriented coping was the only factor that proved minor divergence [9].

CASQ (*Coping Across Situations Questionnaire - Seiffge - Krenke, 1995*, used by Hanzlova and Macek (2008) facilitates assessing situational impact on coping preferences. It consists of 20 coping strategies and respondents have to mark all strategies they might use in a particular domain. The sample was comprised of adolescents attending schools in Moravia, Czech Republic, ranging from 6th class elementary school to 4th class secondary school. The goal of this study was to identify coping strategies utilised in stressful events. They focused on coping strategies in 8 following domains: school (assessment, relations with schoolmates, quantities of information, etc.), parents (understanding, demands, different views, acceptance, freedom in decision-making, independence, etc.), peers (mutual interests, making friends, accepting an individual in a community, etc.), leisure time (lack of free time, parents' limitation, etc.), opposite gender (meeting a partner, socialising with opposite gender, fear of hurting other person, etc.), self (solitude, appearance, dissimilarities from others, etc.), profession, future. [10]

Ayers a Sandler (1996) used *CCSC* (Children's Coping Checklist Strategies) questionnaire to determine most commonly resorted school children's coping strategies. It contains 11 coping strategies as follows: Cognitive Decision Making (CDM), Direct Problem Solving (DPS), Seeking Understanding (SU), Positive Cognitive Restructuring (PCR), Expressing Feelings (EF), Physical Release of Emotion (PRE), Distracting Action (DA), Avoidant Action (AA), Cognitive Avoidance (CA), Emotion Focused Support (EFS) and Problem Focused Support (PFS).

The investigated sample contained elementary school participants aged 9 – 13. One sample was comprised of younger children

and the other sample children aged 11 and over. The questionnaire was designed to identify the most frequent coping strategies utilised by children in schools. The investigated sample featured 367 children whose parents are or are being divorced. The main goal of the analysis was to reveal coping styles of children in divorced families. Furthermore, they examined divergence of coping strategies preference in relation to gender and age of a child. The findings suggest that no divergence of coping strategies preference related to gender and age was proved. [1]

2. Empirical Research of School Stress Levels and its Coping Strategies (CCSC)

The primary focus of our study was the extent of school stress and its coping styles. CCSC (*Children's Coping Checklist Strategies*) became an essential tool of our research. The main goal was to analyse a sample of senior elementary school children in order to determine the extent of stress perceived and to identify the most commonly utilised coping strategy. Moreover, the study was aimed to make a comparison of most frequently used coping strategy in respondents with higher stress levels perceived and respondents who perceived lower stress levels.

We presumed the following:

- H1: The highest percentage of senior elementary school students perceive considerable extent of stress.
- H2: The highest percentage of respondents "often or always" utilise "distracting action" (DA) and "avoidant action" (AA).
- H3: The highest percentage of girls "often or always" utilise "emotion focused support" (EFS) and the highest percentage of boys "often or always" utilise "physical release of emotion" (PRE).
- H4: The selection of coping strategies is influenced by the extent of perceived stress.

H4a: Children with high level of perceived stress will "often or always" utilise "emotion focused support" (EFS) and problem focused support (PFS).

H4b: Children with low level of perceived stress will "often or always" utilise "distracting action" (DA), "avoidant action" (AA) or "cognitive avoidance" (CA).

The investigated sample was composed of 298 children attending Elementary School of St. Gorazd in Puchov (163 girls and 135 boys). The questionnaire was administered in November 2008.

Following methods and methodology were implemented so as to determine the extent of perceived stress and to explore most common coping strategies used by senior elementary school children:

Perceived stress questionnaire [14] – the questionnaire was proposed to determine the extent of stress perceived by school children and adolescents.

The Children's Coping Strategies Checklist (CCSC) – the questionnaire devised by Tim S. Ayers a Irwin N. Sandler (1999) is used to determine most frequently utilised coping strategies.

The Children's Coping Strategies Checklist (CCSC) – the 45-item questionnaire contains 11 coping strategies. The question "What did you do when you had a problem last month?" appears after every 10 responses to remind the participants what kind of question they are responding to. The assessment of the questionnaire is based on a 4-point scale.

In order to verify assumption 4 it was inevitable to select respondents with high and low levels of perceived stress. Respondents were divided into two groups according to perceived stress levels; 50% of children with the highest score were placed in the group of high levels of perceived stress and 50% of children with the lowest score were placed in the group of low levels of perceived stress.

Coping strategies according to Ayers and Sandler (1996)

Table 1

Coping strategy	Characteristics
<i>Cognitive decision making (CDM)</i>	Planning or thinking about ways to solve the problem and thinking about how it will affect the future.
<i>Direct Problem Solving (DPS)</i>	Efforts to improve the problem situation through changing oneself or others. It does not regard thinking but executing things.
<i>Seeking Understanding (SU)</i>	Efforts to find meaning in a problem situation or try to understand it better.
<i>Positive cognitive restructuring (PCR)</i>	Thinking about things in the future with an optimistic manner. Minimizing the problem or the consequences of the problems.
<i>Expressing feelings (EF)</i>	Verbal expression of feelings.
<i>Physical Release of Emotion (PRE)</i>	Efforts to physically work off feelings with physical exercise, play or efforts to physically relax
<i>Distracting action (DA)</i>	Efforts to avoid thinking about the problem situation by using distracting stimuli, entertainment or some distracting activity.
<i>Avoidant action (AA)</i>	Efforts of avoiding the problem by staying away from it or leaving it.
<i>Cognitive Avoidance (CA)</i>	Efforts of avoiding the problem by using fantasy.
<i>Problem Focused Support (PFS)</i>	The use of other people as resources to assist in seeking solutions to the problem situation.
<i>Emotion Focused Support (EFS)</i>	The involvement of other people in listening to feelings or providing understanding to help the person.

4. Analysis and Interpretation

Assumption H1 suggests that the investigated sample of children will perceive high stress levels.

Perceived stress levels in students of elementary schools Table 2

Stress levels	Number of children (in per cent)
High stress levels	11.8%
Low stress levels	20.1%
Medium stress levels	68.1%

Based on the results, we can draw a conclusion that our assumption that high levels of perceived stress will be the most notable in senior elementary school students, was not proved. The findings suggest that senior elementary school students do not perceive stress to such a considerable extent as it was presumed.

It is estimated that approximately 10% of students perceive high levels of school stress. The estimates are grounded in students' own feelings about school (anxiety, fear) and symptoms induced by stress (stomachache, nausea). [14]

The research was deliberately not conducted before the end of the school term when students perceive higher levels of stress due to exams, tests and assignments deadlines.

The percentage of children perceiving high levels of stress grows considerably in periods when they are exposed to particular pressure, e.g. before an important exam. Hodge et al. (1997) conducted a research focused on a comparison of school stress levels in a sample of 446 students, aged 16-18 in New South Wales, Australia, preparing for graduation exams. Students completed the questionnaire commonly used for identifying risk of mental problems. More than a half of students' results exceeded the risk limit and their values even rose towards the impending exams. [14]

The goal of this study was to explore most commonly used coping strategies of senior elementary school students. Assumption H2 suggests that the investigated sample of children will mostly deploy "distracting action" (DA) and "avoidant action" (AA) coping strategies.

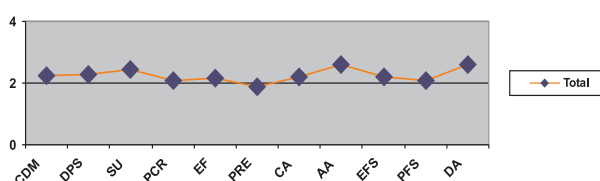


Diagram 1: Preference of coping strategies in senior elementary school students

Diagram 1 shows that children tend to avoid problems as most commonly utilised coping strategies are "distracting action" (DA), "avoidant action" (AA). They are used by more than a half of respondents. Another strategy significantly preferred by children is "seeking understanding" (SU). The least favoured strategies were "physical release of emotion" (PRE), "positive cognitive restructuring" (PCR) and "problem focused support" (PFS).

When comparing the results of our research with Amirkhan's results of the research (CSI, *Coping Strategy Indicator*, 1990), we can conclude that most frequently utilised coping strategy in both cases is "avoidant action" (AA).

On the contrary research carried out by Hanzlova and Macek (2008) by means of CASQ (Coping Situations Questionnaire - Seiffge-Krenke, 1995) reveals that the most commonly utilised coping strategy is active problem solving and reflections about possible solutions.

Assumption H3 suggests that the highest percentage of girls "often or always" utilise "emotion focused support" (EFS) and the highest percentage of boys "often or always" utilise "physical release of emotion" (PRE).

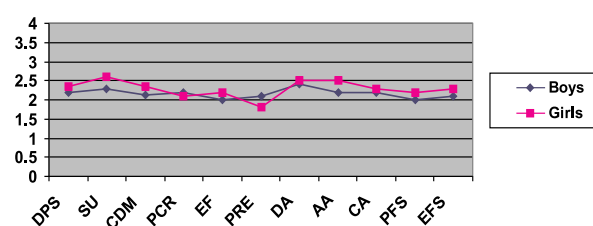


Diagram 2: Preference of coping strategies in relation to gender

Assumption H3 was not proved as the research revealed that girls "often" utilised "seeking understanding" (SU) and not the presumed coping strategy "emotion focused support" (EFS). Boys "often" use "distracting action" (DA) as a coping strategy instead of presumed "physical release of emotion" (PRE). Both genders favour "seeking understanding" (SU), "distracting action" (DA), "avoidant action" (AA). However, some divergence between boys and girls has been observed in the least utilised coping strategies. Girls declare that the least utilised coping strategies in stressful events are "physical release of emotion" (PRE) and "positive cognitive restructuring" (PCR). Boys' least preferred coping strategies include "expressing feelings" (EF) and "problem focused support" (PFS).

Research carried out by Hanalova and Macek (2008) by means of CASQ (Coping Situations Questionnaire - Seiffge-Krenke, 1995) reveals differences in coping strategies preference in relation to gender.

The outcomes showed that girls tend to reflect on problems and they come up with various solutions to a problem, discuss the

problem with parents or someone else, seek consolation and support in people with similar problems, they openly speak about the problem and are willing to accept their limitations. It can be summed up that they speak about the problem more frequently, seek social support and respect reality. Boys, on the contrary, tend to conceal their problems and act as if everything was all right, they do not worry about things as they believe that problems will be settled and they tend to resort to alcohol and drugs more often. It can also be noted that girls prefer to seek help to their problem from friends rather than from their parents and boys vice versa.

Assumption H4 presumes that the selection of coping strategies is influenced by the extent of perceived stress. The basic assumption was subdivided into two partial ones:

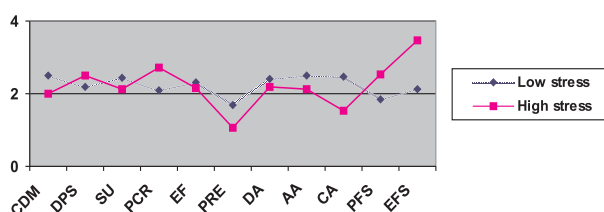


Diagram 3. Selection of coping strategies in relation to the extent of perceived stress

Verification of the the assumption H4a was targeted at finding whether the children who perceive high levels of stress select coping strategies different from those with low levels of stress. We assumed that the children who perceive high levels of stress “often or always” utilise “emotion focused support” (EFS) and “problem focused support” (PFS). Our assumption was based on the hypothesis that the children who perceive high levels of stress will seek help from their parents, friends or acquaintances.

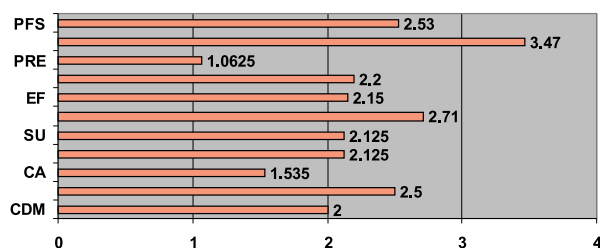


Diagram 4: Coping strategies preference of children who perceive high levels of stress

Based on the analysis of the values of particular items we can draw a conclusion that the most frequently utilised coping strategies are “emotion focused support” (EFS) and “problem focused support” (PFS). The results of our findings thus match our assumption. Children who perceive high levels of stress “almost always” seek help from other people. However, it does not regard direct help; they seek the involvement in listening to feelings or provid-

ing understanding to help the person. Another coping strategy rather frequently utilised by children who perceive high levels of stress is “positive cognitive restructuring” (PCR), which means thinking about a problem in a positive manner or minimising the problem. The least utilised coping strategies are “physical release of emotion” (PRE) and “cognitive avoidance” (CA).

Verification of H4b assumption was aimed at finding if children perceiving low levels of stress utilise coping strategies different from children with high levels of stress. It was presumed that children perceiving low levels of stress “often or almost always” utilise “avoidant action” (AA), “distracting action” (DA) and “cognitive avoidance” (CA). Our assumption was based on the hypothesis that the children who perceive low levels of stress will not attempt to solve the problem directly but will tend to evade it as they do not assign it great importance.

The findings of our research suggest that the three most frequent coping strategies utilised by children perceiving low levels of stress are evasive strategies. Children perceiving low levels of stress “often” use “distracting action” (DA), “avoidant action” (AA) and “cognitive avoidance” (CA). Based on the results of our research it can be concluded that children who perceive low levels of stress tend to avoid stressful events by choosing to leave, doing something different or escaping reality by means of fantasy. The least utilised coping strategies are “emotion focused support” (EFS) and “problem focused support” (PFS). “Physical release of emotion” (PRE) is another less frequently opted coping strategy. Our assumption that children perceiving low levels of stress will “often” use “distracting action” (DA), “avoidant action” (AA) and “cognitive avoidance” (CA) matches the outcomes of our findings.

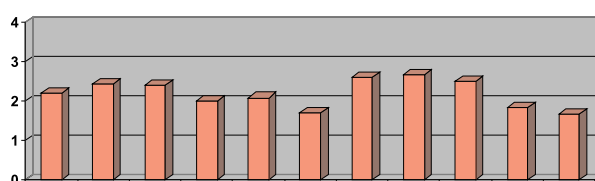


Diagram 5: Coping strategies preference of children who perceive low levels of stress

5. Conclusion

Coping with stress and stressful events is of vital importance for pupils. This is, however, in a sharp contrast with the fact that only very little attention is paid to a systematic training of coping with load both in real life and psychological research. The necessity of such a training is only discussed in cases when an individual could not bear the load of a failure at school and resorted to an act of sheer desperation (running away from home, suicidal attempt) [7]

Bratská (*Constructive solution and coping with load*, 2004) suggests a perspective of a group therapy focused on coping with load

in order to get acquainted, compare and adopt various techniques in accordance with awareness of possible consequences.

The programme is applicable in miscellaneous groups in nursery schools, elementary schools, secondary schools, universities as well as at third age universities. The program presents a constructive, efficient and creative solution and coping with load. Moreover, it analyses support of active adaptation to difficult conditions in a social system and development of communication and interpersonal skills. The principal psychological objective of the programme is to enhance social competence of participants with regard to constructive, efficient and creative solution and coping with load. [6]

Changes in reactions to potentially stressful situations at school are desirable outcomes of coping strategies training. The main goal according to Mareš [15, p.563] is to teach pupils wide range of coping strategies, proper assessment of the situation or possibly unteach them generally inappropriate or situationally disadvantaged strategies.

It can be concluded that age-appropriate load with a suitable adopted coping strategy may have a positive impact, it can enhance personality development, it can trigger changes, or it can be a challenge or a chance to achieve something.

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Danica Gondova *

USING ACTIVITIES AS A WAY OF PROCEDURALIZATION OF LEARNERS' LANGUAGE KNOWLEDGE

The new education law [20, p. 5] emphasizes the importance of studying foreign languages in which learners should gain communicative competence and reach B2 level of the Common European Framework [2007] when they finish their secondary education. In order to achieve this objective, learners need to gain procedural knowledge of the target language. This objective is achievable if teachers activate learners and let them construct their own meanings of language in activities focused on gaining not only declarative knowledge, but also language habits and secondary language skills. Activities enable learners to work independently; teach them to think productively; and thus contribute to the development of their cognitive skills and autonomy. The multi-directional communication helps learners gain communicative competence and contributes to learners' socialization.

Key words: proceduralization of knowledge, declarative knowledge, accuracy-focused activities, fluency-focused activities, language habits, secondary language skills, activating methods

1. Introduction

Since September 2008, the education reform introduced immediately after the change in 1989 has been taking place in Slovakia. The Education Law No. 245/2008 Coll., passed in May 2008, emphasizes those changes in the content of education that are aimed at the development of general and cognitive competences of learners [1, p. 61], as well as communicative competences gained not only in the mother tongue but also in at least two foreign languages [20, p. 5].

Based on this context, we analyze the objectives of foreign language learning and discuss the importance of explicit and implicit language for the achievement of these objectives. In addition to that we discuss differences between techniques and activities and offer a definition of those activities that engage learners with the learning process and help them gain not only explicit but also implicit language knowledge and thus achieve the objectives of language learning.

2. Engagement with the learning process

The communicative approach to language learning is based on the theory of constructivism and as such it lays particular stress on the importance of experience, contextualization and authenticity. "The learning of skills and sub-skills, automatization of skills, meaningful learning (carrying out meaningful tasks) is preferable to rote learning. Emphasis is put on procedural knowledge and

skills are automatized through controlled processing. Knowledge of a language, which is based on knowledge of actual usage, is dynamic. It changes in accordance with a person's linguistic experience [15, p. 53]."

This means that learners need to take an active part in the learning process, to construct meanings in the foreign language, produce restricted and/or authentic output and use language in a variety of communicative situations. In order to achieve the communicative competence as it is defined in the Common European Framework [5, p. 13] it is necessary to use activities that make these objectives achievable, activate learners and make multi-dimensional interaction possible.

[17, p. 41] defines *activity* as "the basic building block of a lesson... as something that learners do that involves them using or working with language to achieve some specific outcome." This understanding of an activity makes it clear that whatever is done by the teacher in the classroom (e.g. grammar explanation) is not considered an activity and should be referred to as technique [2, p. 16]. The concept of an activity also differs from that of a task which [19, p. 23] understands as "a goal-oriented communicative activity with a specific outcome, where the emphasis is on exchanging meanings not producing specific language forms."

In our conditions, most pupils and students learn a foreign language in school conditions, and usually are not exposed to them or do not use them in real communicative situations outside the class. Therefore, we believe that it is essential for them to have suf-

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ficient accuracy-focused and fluency-focused practice at school which they can get through engagement with activities. Similarly to [17, p. 41], we also define an activity as something that learners do by themselves and (if possible) independently from the teacher. It involves them in working with or using the target language, in other words, in producing a purely 'for-the-purposes-of-learning' (grammatical or vocabulary exercises) or 'real-world' outcomes (meaningful, communicative activities).

3. Declarative and Procedural Language Knowledge

Language learning is a very complex process, and teaching and learning foreign languages has its specifics since the ultimate objective for learners is to gain the communicative competence and master language skills not language knowledge. At the end of the course learners do not need to know about language (explicit or declarative knowledge), but they need to be able to use it and they need to have language habits and secondary language skills (implicit or procedural knowledge) [3, p. 43]. In other words, learners do not need to be able to talk about grammar but they need to be able to use it for communicative purposes. Therefore, effective language learning methods are those that lead to achieving all communicative sub-competences and within them – the language skills.

[4, p. 74] differentiates three types of objectives in language teaching: language, cognitive and affective objectives. Yet, he considers the language objective, which is gaining the communicative competence, to be the most important. He also emphasizes the significance of cognitive objectives, but these are linked with the extra-linguistic reality. This is because learners use the target language as a means to solve real-life problems. As such these are not the primary goals of language learning. The position of affective objectives in foreign language learning has a position similar to that of cognitive objectives.

[11, pp. 28–30] understands foreign language learning as a kind of movement from explicit to implicit knowledge or from declarative knowledge to its proceduralization. In her understanding conscious and declarative (explicit) knowledge (about language) has its meaning particularly if learners study the foreign language in school conditions because they have few opportunities to acquire language outside the school. In this case the explicit knowledge may accelerate the process of learning; however, it must be followed by the process of proceduralization. During the proceduralization process the explicit knowledge changes into procedural (implicit) knowledge, thanks to which learners gain secondary language skills [4]. "Explicit knowledge is declarative, while implicit knowledge is subconscious and procedural even though not necessarily automated" [11, p. 35].

From the point of grammar, which is often considered to be the core of language learning by both learners and teachers, explicit knowledge of rules is not sufficient; one also has to understand them either intuitively or consciously. Learners do not need to verbalize rules, but have to be able to use language structures cor-

rectly. It is necessary to remember though, that in order to gain explicit knowledge learners need to be cognitively mature. This approach can be used with adults (including lower and upper secondary school students) whose cognitive thinking is already developed.

To conclude, even though teaching explicit knowledge is necessary, it is not sufficient and has to be followed by proceduralization. Practising language on sentence level (decontextualized exercises) is not enough. Learners need to be put in situations in which they are made to use the target structures in communicative activities. Teachers in Slovakia proclaim that they use communicative activities, but research results show [11, pp. 53–54] that in the teaching process they emphasize the importance of declarative knowledge which they tend to overestimate. On the other hand, learners are frustrated because they realize that their procedural knowledge has not been developed sufficiently. Similarly, in her research [14, p. 58] found out that learners achieve better results in discrete-item test-tasks than they do in language-in-use tasks even though their teachers declare that in the teaching process they use communicative activities.

4. Accuracy Focused and Fluency-Focused Activities

In order to achieve the objectives of foreign language teaching, teachers need to use a variety of activities which enable learners to gain language habits and/or secondary language skills, and which should prevail in language lessons. From this it follows that teachers should reduce the time spent on explaining grammatical rules and follow-up drills and support learners in using language in real-life situations [15, p. 60].

In the 1960s [12] divided techniques used in foreign language learning into manipulative and communicative. Manipulative are those in which the learner "receives the words or structures from teacher, tape or book", on the other hand, communicative are "those that allow the student himself to find the words or structures he uses" [12, p. 3].

Nowadays the activities are differentiated in the same way. The most important aspect is the degree of language control by the teacher. On the one side of the continuum there are accuracy-oriented activities, in some literature also referred to as controlled or systems-oriented activities. These are considered to be traditional and controlled techniques are commonly used in the grammar-translation method and/or audio-lingual method [10]. Through semi-controlled and semi-free activities learners proceed gradually to the other side of the continuum to the activities that are fluency-focused (also referred to as free or skills-oriented). The freer is the language whose production is made possible by an activity, the more effective is the proceduralization of language knowledge and the development of secondary language skills.

The transition from controlled to free activities is usually phased and fairly slow. The order of the activities is important and the teacher needs to choose them carefully so that learners can

proceed from easier to more demanding tasks. Accuracy-oriented activities are easier for learners because the language they have to use is given to them. They are done in pairs or in small groups and thus they activate learners, are learner-centred, and help learners construct their own meanings of language structures. From the point of view of language they are manipulative because learners' responses can be predicted. On the other side of the continuum there are activities whose main objective is communication; the language learners use to talk about opinions, feelings, or attitudes is open and not predictable. These are considered as communicative because they enable the independent production of language used for expressing one's own ideas in a multi-directional communication.

Communicative activities help learners achieve the objective of language learning which, as mentioned above, is gaining communicative competence. That means being able to interact in various socio-linguistic situations and applying both explicit and implicit knowledge in one's own creative production of language in order to express one's own thoughts, feelings, experiences and attitudes. Among the characteristic features of authentic communicative situations is their complexity that requires the so called total skills, not isolated skills [15, p. 67]. The integration of language skills (total skills) in real-life communicative situations and in real time means that learners have to be able to decode the language they receive, i.e. analyze and comprehend the utterance they are listening to or reading and formulate the answer readily which, of course, requires implicit language knowledge.

4.1 Classification of Activities in Foreign Language Learning/Teaching

In order to achieve the above mentioned goals, it is necessary to activate learners at all levels of language proficiency and at all stages of language learning. For these reasons we differentiate:

- activities which enable learners to gain explicit knowledge;
- activities which enable learners to gain language habits;
- activities which enable learners to gain secondary skills and communicative competence.

From this it follows that activities:

- enable learners the proceduralization of language knowledge, i.e. the development of language habits and secondary skills; while using them learners are allowed to produce partly restricted or authentic language; express their own ideas, and opinions, and to control the meaning of their utterances using the implicit language knowledge;
- enable learners to gain explicit language knowledge; even though they do not lead directly to gaining language habits and skills, they make it possible for learners to comprehend rules, forms and meanings of grammatical structures, vocabulary, pronunciation and spelling.

Generally, methods that enable multi-directional communication and independent work of learners are often referred to as activating methods [6, p. 72]. They require learners to solve various

problems; develop learners' higher-order thinking skills; and teach them responsibility for their own learning. Some of them can also be used in foreign language teaching. Our classification of these activities is based on the classification of activating methods worked out by [12, pp. 108–130], and we have classified them into the following groups:

- (group) discussions
- drama activities and role plays
- simulations
- games
- discovery activities (heuristic methods)

Discussions performed in small groups focus on exchanging ideas or experiences, solving moral dilemmas, or expressing opinions on global issues. Learners gain the experience of presenting their opinions, arguing, justifying their cases, but on the other hand they also learn how to listen to other people and learn to understand and tolerate their points of view. Even though the language goal of the discussion is practising speaking for fluency, it is essential that learners also achieve the extra-linguistic goal of the discussion and arrive at a compromise, solve a problem, make a suggestion or persuade the others. This is because the language is not taught for the sake of language, it is taught as a means of communication and needs to be used in language lessons like that. Discussions are demanding from the language point of view, as well as from the point of cognitive skills of learners and are, therefore, used with more advanced learners. Among the most common discussions are *group discussions*, *pyramid discussions*, or *debates* (which are more formal than discussions).

On the other hand, role-plays and various drama activities can be used at all levels and with all age groups. They may be controlled, e.g. in *situational dialogues* in which learners practise functions of the language, and find out what language, and how it is used in various social situations; or in grammar-oriented role-plays. At low levels of language proficiency, role plays and drama activities are rehearsed. At higher levels they may also be used to practise language for fluency, which means learners play the given roles without rehearsing them. The advantage is that role-plays and drama activities simulate various social situations thanks to which learners are not limited by the language which is commonly used in the classroom: they can be angry or excited; they can be on a trip or in a shop; they can play surgeons or journalists. In more creative activities they can be asked to dramatize a story, play the ending of a story or perform a dialogue between two characters.

Simulations differ from role-plays in that learners play themselves and behave in the same way they would if they were in the same situation outside the class. Among the most common simulations are interviews (learners interview each other to gain some personal information) and surveys (oral or written). Depending on the objectives, they can be placed anywhere on the continuum between controlled and free activities. For example, surveys known as *Find someone who* are highly controlled; on the other hand, learners can be asked to do a survey in which they use language freely.

Another group of activities used in the language classroom are games which are motivating and activate learners. There are lots of various games used for language learning. Many of them are controlled, but some of them enable learners to produce language freely. [8, p. 97] divide games into interactive and non-interactive. Interactive games require the co-operation of learners. In these games learners communicate together and influence each other. In games which are not interactive learners work individually and the results of their activity are not dependent on the others (quizzes, crossword puzzles). Even though games are very motivating and can be used in any stage of the lesson, some authors warn against using them too often because many of them concentrate on isolated words and are de-contextualized [18, p. 102]. Many authors also warn against using competitive games frequently because they may discourage slow-learners or low-achievers from participating in them.

As far as heuristic methods are concerned, discovery activities which help learners 'discover' grammatical rules are most commonly used. Learners do not discover rules completely by themselves; they are guided either by their teacher's questions or by questions in the textbook. The questions may concentrate on the form, function or use of a grammatical structure. In other discovery activities learners may also be asked to discover rules of pronunciation or spelling or to discover the meaning of new vocabulary through identification, selection, matching, classifying, etc. Among heuristic methods are also tasks in which learners are asked to predict the content of a text or the continuation of a story (in pre-listening or pre-reading activities or during the process of listening or reading), various kinds of projects and brainstorming.

The use of the above mentioned activities depends on the language level of learners. Especially those that require them to produce authentic output and to use language in unrehearsed situations creatively can only be used if learners' language proficiency is on, at least, B1 level of the CEF because in order to enjoy doing them learners must have already developed some secondary language skills. If used reasonably, however, they help learners to understand that the foreign language is a means of communication, not just one of the school subjects.

4.2 Characteristic Features of Activities

Learners' activity in the learning process has been justified by the constructivist theory of learning. Active participation in learning contributes to the development of learners' personalities, and their cognitive and affective skills. In the following part we will briefly mention some characteristic features of activities and discuss their influence on learners' personalities.

Above all, we will mention that learners' activity has a strong influence on the development of positive affective qualities, as well as on their motivation. The involvement and engagement with the learning process enabled by the use of activities (or activating methods) supports the development of learners' positive affective qualities. According to [7, p. 121] positive affective qualities are

essential because they have the potential to influence the success in learning. Learners whose attitudes towards a subject, a teacher or the subject matter are positive are likely to be motivated and achieve good results.

Positive affective qualities play a great role in language learning as well. In addition to giving learners opportunities to work actively and be engaged in the learning process it is also important that the teacher creates such an atmosphere in the classroom in which learners are not afraid to talk in a foreign language even though they are aware of errors they make. The teacher should also respect their new "language ego" intertwined with the second language" because it "can easily create within the learner a sense of fragility, a defensiveness, and a raising of inhibitions [2, pp. 61-64]." Positive affective qualities also influence the intrinsic motivation of learners which is considered to be one of three basic conditions of successful language learning [19, p.14].

Another characteristic feature of activating methods is the development of cognitive functions of learners (creativity, evaluation) because they are asked to solve various problems independently. In foreign language learning creativity is understood as the ability to comprehend and produce language in unrehearsed communicative situations, which requires receptive and productive creativity. In other words, learners are able to understand unknown texts (the analysis of the language learners are exposed to) and use the target language to express their own ideas (the creative production of the target language). In addition to that their creativity is also developed in various problem-solving tasks in which the problems are usually linked with the extra-linguistic reality. Through expressing their opinions, feelings and attitudes learners solve these problems using the target language as a means of communication. In discovery activities which help learners gain explicit language knowledge learners use their higher-order thinking skills to solve language problems dealing with the form, meaning and use of language structures.

Furthermore, activating methods (activities) contribute to the socialization of learners' behaviour. The abilities to co-operate, listen to and tolerate the opinions of others are necessary pre-conditions of team work. Many authors stress the importance of such co-operation because it increases learners' ability to adapt to various conditions and be responsible for each other and their learning. In co-operation with their peers they also learn to understand values, respect each other and become more self-confident.

Another aspect that we would like to pay attention to is classroom communication because it influences the learning process, learning styles, as well as the activity of students. In a traditional classroom knowledge is transmitted to learners, they receive it passively and the time for practising their skills as well as student talking time is reduced. On the other hand, activities open space for active participation of learners and for multi-dimensional communication (communication between learners, not only between the teacher and a learner). Kinds of questions are another important aspect of classroom communication. Referential questions and production questions open space for genuine communication and for productive use of language.

4. Conclusion

In conclusion, doing activities in language classroom is a great contribution for learners because they help them develop self-confidence, creativity and spontaneity without being afraid of failure [9]. They also make it possible for learners to take an active part in the learning process, develop creative competences, learn to co-

operate in groups, become aware of their own attitudes and values, take part in decision-making and evaluate. Their application in foreign language lessons helps learners understand explicit language knowledge much better and, which is much more important, it helps them gain implicit knowledge, language habits and finally secondary language skills and thus acquire the communicative competence which is the ultimate objective in language learning.

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Zdena Kralova – Rastislav Metruk *

TELEVISION PROGRAMMES IN THE ACQUISITION OF ENGLISH PRONUNCIATION

The study analyzes the influence of watching authentic TV programmes in English on the non-native speakers' level of English pronunciation. We tried to detect the correlation between frequency of watching TV programmes and perceptual analysis of English pronunciation of our respondents which was done by native speakers.

Key words: English pronunciation, authentic TV programmes, correlation.

1. Introduction

Pronunciation is one of the most difficult aspects of language for a student to learn and some of them wish, in a long-term perspective, to pronounce at the level native speakers operate at, or at least, to be as close to this level as possible, which may well be a crowning achievement for an English foreign learner. A foreign learner has a number of methods to choose from which may vary in many ways. There exist many extralingual and interlingual factors which influence our pronunciation. Each and every one of us has their own ability to acquire foreign language pronunciation. Psychological and biological factors may play a key role, but we must not forget to mention the methodological determinants of pronunciation learning and acquisition [1].

The relevant studies published so far, which were focused on the analysis of factors of foreign language phonic competence and performance, vary in several dimensions, such as subjects, objects, methods or processes of the research. In order to improve a learner's pronunciation, one must be determined to work rather hard. An individual imitates the pronunciation of another person mainly when they are positively identified with that person. The combination of feeling and thinking can increase the quality of perception and production; therefore, the relation to foreign language speakers and culture is of positively stimulating character. In our quasi-experiment we concentrated on watching TV programmes as one of the means to improve English pronunciation and we tried to find out whether the frequency of watching TV programmes correlates with one's pronunciation quality or not [2].

2. Methodology

We worked with a group of 26 people. All of them were first year students of English language and literature at the Faculty of Science at the University of Zilina. The perceptual analysis was made by five English native speakers. Three of them were Americans, one was Briton and one was Australian. Each of them was a professional English language teacher.

Each respondent produced a 1-minute spontaneous monologue in the English language, which was digitally recorded for perceptual analysis. The topic of utterances was autobiographical. In addition, the respondents were asked to fill in a questionnaire which focused on watching television programmes. The questionnaire was completed after the recording. Pronunciation quality of the respondents was evaluated by the native speakers who were using a perceptual evaluation method. The students were given a rating from one to five where five is considered to be an excellent pronunciation and one is thought to be a poor one (Table 1).

Scale of perceptual evaluation Table 1

Code	Evaluation of pronunciation
5	excellent
4	satisfactory
3	good
2	fair
1	poor

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Questionnaire

The questionnaire was created to find out why and how often the students of English language watch authentic TV programmes in English. We coded the questionnaire data (frequency of watching) in a 5-point descending scale (Table 2).

Scale of frequency

Table 2

Code	Frequency of watching
5	every day
4	two/three times a week
3	once a week
2	once in two weeks
1	once a month

1. Do you watch any authentic television programmes in English (e. g. sit-coms, serials, films, news etc...)?
2. If so, how often?
3. Are you able to name some particular programmes you watch and some particular TV stations or other sources you watch these programmes on?
4. Do you usually watch programmes broadcast in British English, American English or other?
5. In case you watch these types of programmes, do you watch them with subtitles? If yes, write the name of the language the subtitles are in, please.
6. What is the reason you watch these programmes?

Procedure

1. We recorded spontaneous English monologues of each respondent. The average length of the utterances was 1 minute.
 2. After the recording session, each respondent was asked to fill in the questionnaire.
 3. Five English native speakers perceptually evaluated the recordings on a scale of 1 to 5. An average evaluation for each respondent was calculated (Table 3).
 4. We coded the questionnaire data (frequency of watching) on a scale of 1 to 5 (Table 2).
 5. The pronunciation and frequency data were related by a simple correlation (Table 4).
- At a level of significance 0.1, for the group of 26 people, the relevant correlation coefficient is 0.260.
6. We analysed additional data from the questionnaire (Figs 1-4).

3. Results

A simple correlation administered in Microsoft Excell by using function Correl (array1; array2) was used in order to calculate the correlation coefficient. The correlation coefficient which expresses the dependence of frequency of watching TV programmes and the level of pronunciation of the respondents (0.1518) is lower than

Coding the perceptual analysis and questionnaire data

Table 3

Respondent	NS ₁	NS ₂	NS ₃	NS ₄	NS ₅	Evaluation mean	Frequency
1.	3	4	3	3	4	3.4	1
2.	4	4	3	3	3	3.4	3
3.	4	3	4	3	3	3.6	5
4.	2	3	3	4	3	3	2
5.	3	3	3	3	3	3	4
6.	3	3	4	4	3	3.4	1
7.	3	3	2	3	3	2.8	3
8.	2	3	3	3	3	2.8	3
9.	4	3	3	3	3	3.2	5
10.	4	3	3	3	4	3.4	5
11.	5	3	4	5	4	4.2	2
12.	2	3	3	2	3	2.6	4
13.	2	3	2	3	2	2.4	3
14.	2	3	2	1	2	2	3
15.	5	4	5	5	5	4.8	5
16.	3	3	3	2	4	3	3
17.	2	3	4	3	3	3	4
18.	3	3	3	3	3	3	3
19.	3	3	3	4	3	3.2	5
20.	4	3	3	3	3	3.2	3
21.	3	2	3	2	3	2.6	3
22.	3	3	3	3	3	3	5
23.	3	3	3	3	2	2.8	3
24.	2	4	3	3	3	3	3
25.	3	3	3	2	3	2.8	3
26.	2	2	3	3	3	2.6	3
Mean	3.04	3.08	3.12	3.04	3.12	3.08	3.35

NS - English native speaker

the critical value for the group of 26 respondents at a level of significance 0.1 (0.260). Therefore, the correlation is not evident and the relationship of analysed variables was not confirmed.

Correlation of pronunciation and frequency

Table 4

Respondent	Pronunciation	Frequency
1.	3.4	1
2.	3.4	3
3.	3.6	5
4.	3.0	2
5.	3.0	4
6.	3.4	1
7.	2.8	3
8.	2.8	3
9.	3.2	5
10.	3.4	5
11.	4.2	2
12.	2.6	4

13.	2.4	3
14.	2.0	3
15.	4.8	5
16.	3.0	3
17.	3.0	4
18.	3.0	3
19.	3.2	5
20.	3.2	3
21.	2.6	3
22.	3.0	5
23.	2.8	3
24.	3.0	3
25.	2.8	3
26.	2.6	3
r	0.1518	

It is vital to mention that even a strong correlation does not necessarily provide evidence of a mutual relationship between variables. Thus, the interpretation of variables is not straightforward and has (within our findings) a more informative character. The experiment can be considered a suitable illustration of the discussed issue.

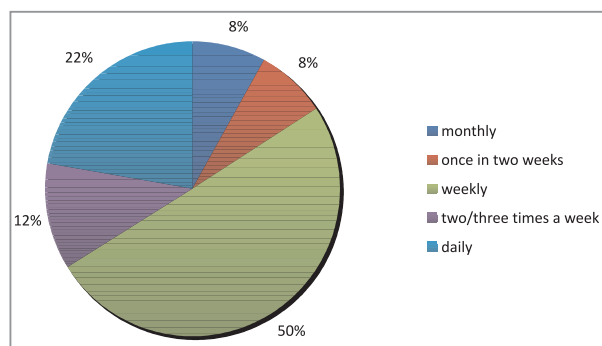


Fig. 1 Respondents' frequency of watching TV programmes

In Table 3 we can see that the average score of the respondents' pronunciation is 3.08. The native speakers' evaluation of the English pronunciation of our respondents indicates that their command of pronunciation is between "satisfactory" and "good". However, we must point out the fact that the topic was autobiographical and if a more difficult and abstract topic had been chosen, the quality of the pronunciation probably would have been lower. In Table 3 we can also find information about the frequency of watching TV programmes in English. The most important fact is that all of our respondents do watch TV programmes at least once a month. As we can see in Fig. 1, most of the respondents watch TV programmes on a weekly basis (50%). We consider relevant that 22% of the respondents watch TV programmes regularly on a daily basis. The main reason stated by them is to improve their overall command of English.

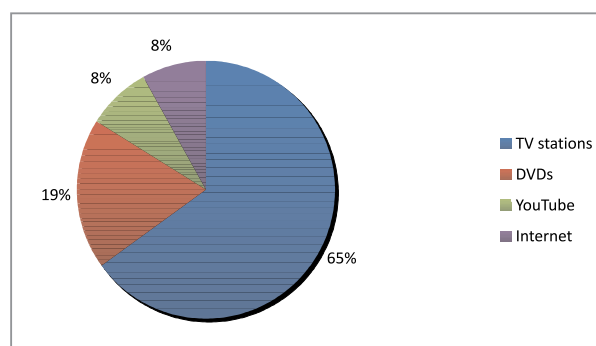


Fig. 2 Distribution of respondents according to the source used

According to Fig. 2, the overwhelming majority of our respondents watch TV programmes via satellite (65%), as they are able to receive the overseas signal. They claimed to watch BBC, CNN, Sky News, Discovery Channel, Eurosport, CBS, FOX and NBC. 19% of them prefer watching these TV shows on original DVDs. This may be supported by the fact that there is a possibility of adding subtitles to the DVD. The remaining 16% like watching TV programmes on the internet. It is vital to highlight the fact that overseas transmission may be expensive and that students operate with a limited amount of money; therefore there may not be an opportunity for them to watch TV programmes from overseas TV stations because it could be over their budget.

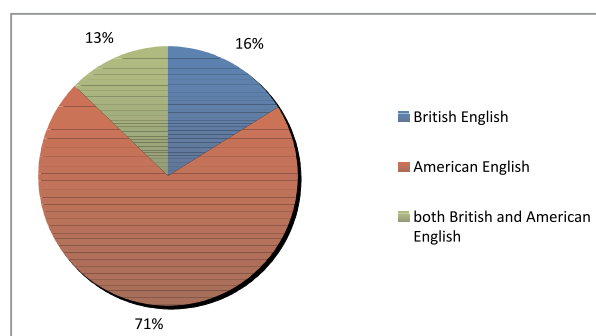


Fig. 3 Perceptual distribution according to the variety of English

As we can see in Fig. 3, the majority of our respondents watch TV programmes in American English. This may be due to the overwhelming influence of the entertainment, film and music industry of the United States of America. American shows are immensely popular and are well known all over the world. There are many television networks with plenty of quality programmes; therefore, there is a considerable amount of competition which may result in a higher number of quality TV programmes which may overshadow TV shows from other parts of the world where English is spoken. We would also like to point out the fact that none of our respondents reported watching TV programmes in Australian English, Canadian English or New Zealand English which resulted in the fact that all of them watch TV programmes in American English, British English or both.

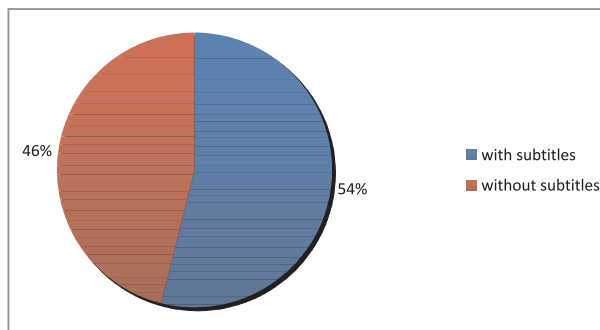


Fig. 4 Distribution of respondents according to subtitles used

Fig. 4 provides information on watching TV programmes with or without subtitles. The distribution is almost equal. Respondents who claimed watching TV programmes with subtitles usually use English subtitles. It is believed to be more efficient than using, for instance, Slovak subtitles. Learners have the opportunity to see, in real time, how the word is spelt, which is one of the advantages when using English subtitles.

Another advantage is when a student encounters a totally new word they have an instant opportunity to search for the word in a dictionary. Not only do they have a chance to see pertinent and extra information about the word, but they also can see the phonetic transcription and hear British or American pronunciation. Furthermore, they can try to pronounce the word on their own which may lead them to pronunciation practice.

However, using subtitles during watching TV programmes may be tricky. Many times while watching TV programmes, learners concentrate only on subtitles instead of what the actors are saying. They are being supported by the subtitles and are not worried when they do not understand the spoken text because they can easily read what actors say on the screen by looking at the subtitles. We may consider this phenomenon to be a way of cheating because in a real-life communication no subtitles are available. In addition to this, if the learners had only been watching TV programmes without subtitles, and had been using subtitles with more sophisticated or complicated language, their understanding might have improved faster. Furthermore, without subtitles the learners can only rely on their own ears and therefore, they must carefully listen to every single word and how it is pronounced which may lead to a slight increase in their own pronunciation accuracy.

Another issue emerges, when using subtitles, that is the decision of whether to use English or Slovak (Czech) subtitles. Some of the respondents claimed to use Slovak subtitles, some English. The decision here is simple; the learner should preferably use English subtitles. As we mentioned earlier, most of the TV programmes use standard and perfect English which make it easier for a learner to understand. Using subtitles is recommended for a learner when they are not sure they understand the message or when they are dealing with more sophisticated, idiomatic, colloquial and complicated language.

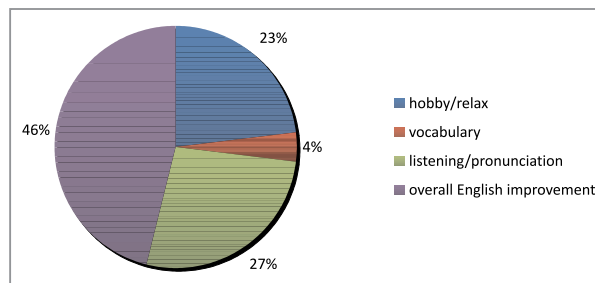


Fig. 5 Reasons for watching TV programmes

Fig. 5 indicates that most of our respondents watch TV programmes in order to increase their general command in English (46%). This counts for listening, speaking, pronunciation, vocabulary, sentence structures, idiomatic expressions, cultural and social English background and others. 27% of respondents state that their major concern in watching these programmes is due to listening and pronunciation improvement. They are trying to repeat the particular pronunciation what subsequently, may lead to better overall pronunciation. Only 4% of respondents watch TV programmes because of vocabulary building and 23% of them have no intention in elevating their overall English, vocabulary or listening/pronunciation, but they only watch TV programmes for relaxation or as a hobby.

4. Conclusions

Within our experiment, pronunciation of 26 students was recorded and subsequently evaluated by English native speakers. The average value 3.08 suggests that the overall pronunciation quality of respondents is between "satisfactory" and "good". This result can be considered an appropriate value based on the fact that respondents were in the first year of their studies.

We found out that the majority of our respondents watch TV programmes weekly. 22% of them watch TV shows on a daily basis, which may be considered to be an important finding because of an everyday exposure to speech produced by native speakers. Most of our respondents watch TV programmes on TV stations via satellite receivers. Two thirds of respondents are being exposed to American English. This may be due to the scope of US film industry. The main reason for watching is to be claimed to improve their overall English skills. Respondents believe that the more they watch English TV the better their overall improvement will be. The distribution of respondents according to whether they use subtitles during watching or not is almost equal. Both, watching with or without subtitles, have their advantages and disadvantages. However, we regard, mainly for higher levels (B2, C1), watching TV programmes without subtitles as more efficient and relevant.

The correlation coefficient indicates that the influence of watching TV programmes on pronunciation is not evident, which does not necessarily mean that there is no impact on one's pronunciation when they are being exposed to authentic English. We

must, however, mention that a number of factors which cannot be measured could have played a minor role within our research. Elements, such as additional pronunciation practice of some respondents, further and more thorough study of English language at home, at language schools and at other institutions, or possibly a stronger interest in pronunciation issue than the majority of other students, studying the relevant materials and others might have influenced the research.

Despite this finding, we think that the influence of watching TV programmes makes some positive impact on one's pronunciation and also on general English knowledge when taking into consideration other aspects of language learning and acquisition, such as vocabulary, listening, phrases, idiomatic expressions and possible exposure to English produced by native speakers. Subsequently, watching authentic TV programmes is extremely popular among the students and learners of English. It may also be an excellent and educational way of relaxing.

Obviously, students agree that watching TV programmes is one of the most exciting parts of learning a foreign language. Excitement, fun and enjoying learning is one of the key factors in English language learning, because a student is being kept motivated. Plenty of dialogues use non-standard diction, which may cause frustration for beginners because they probably will not be

able to understand exactly what is being said. Therefore, it is vital to make a correct decision when choosing an appropriate TV show. Learners are supposed to be taught standard pronunciation, and, of course, when they hear different speech and pronunciation, they might be confused. Students ought to acquire the standard pronunciation first before moving on to "television" language. Generally, we distinguish many TV programmes (among others): situation comedies, soap operas, serials, TV shows, reality shows, news, documentaries, music clips, weather forecasts and movies [3].

We may find a big advantage in authentic television programmes. They provide a learner with live language of various varieties in horizontal and vertical classification of the language (geographical and social varieties). Learners often identify themselves with their favourite characters and their stories and the effect of imitation of the L2 pronunciation is more significant.

In conclusion, we think that in the field of English language methodology, still more and more research should be done in order to reveal the most effective methods of pronunciation training and the most promising ways of pronunciation acquisition because the correct pronunciation, the one which approaches the level native speakers operate at and the one which seems to be so excruciatingly difficult to achieve, may be one of the significant factors of the communication in English language [4, pp. 315].

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Katarína Pankuchova – Andrea Gavlakova *

STRUCTURAL MODELS IN TECHNICAL TEXTS AS A RESULT OF A LINGUISTIC-PRAGMATIC ANALYSIS

Typical structural models in technical language, their use in understanding, translating and producing technical texts as well as in technical language teaching, engineering and technology (word-formation, grammatical and syntactical structural models and their pragmatic-linguistic analysis). Comparison of typical linguistic structures in Slovak, German and English technical texts.

Key words: Technical language teaching, pragmatic-linguistic analysis of a technical text, structural model

1. Introduction

Technical texts as a form of technical and scientific communication nowadays are not only a communication tool of experts but they also affect communication of ordinary language users. Technical documentation, chemical composition of products, safety precautions for handling mechanisms and devices, working procedures, manuals, product parameters etc. best exemplify technical language used in technical texts.

The use of technologies in our everyday life brings about the fact that technical terminology and ordinary language overlap. This interaction concerns e.g. internet or mobile communication terminology, household or workplace equipment terminology, etc.

Requirements laid on various types of technical texts can be classified according to different points of view:

- from the point of view of a consumer; clarity, pertinence, comprehensiveness, informativeness and legibility is assumed, and
- from the point of view of a producer whose market-oriented criteria involve brevity and attraction.

Technical texts aimed at experts and specialists are less comprehensible to ordinary users and their most typical characteristics are professional expertise, terminology, more complex sentence structure.

Communication in the professional area is successful only on condition that all the individuals involved in the communication have mastered the inventory of technical terminology and have sufficient command of communication strategies of verbal and non-verbal nature.

Pekarovicova [1] lists the following prerequisites essential for communication in the technical area:

- “building of fundamental lexical and grammatical apparatus inevitable for verbal and non-verbal behaviour in specific communication situations denominated as technical and communication minimum (composed of inventory of frequent general expressions of categorial meaning),
- understanding of transformational and derivational possibilities of the Slovak language, adopting respective sentence structures and specific terminology relevant to the field of study.”

Pekarovicova recommends creating information and communication base of technical texts by means of “technical communication models comprising word-formation, denomination and syntactical utterances for determination, description or classification of objects and phenomena or demonstrating relations in technical texts” [1, pp. 3–10].

A number of linguists have aimed their research at structural modelling of technical language:

A Slovak linguist Findra in his publication *Stylistics* deals with the analysis of scientific prose style along with the characteristics of “formal model structures” [2, p. 181].

Becker, the author of *Fachdeutsch Technik, Metall-und Elektroberufe* coursebooks series, refers to structural models typical of technical language as “logic structures”. For the teaching process he suggests acquiring “structures” of definition, causality, working procedure etc. Technical phenomena and problems can be described, understood and solved provided we are capable of their linguistic reflection or understanding in logic structures [3, p. 6].

The issue of controlled language (*kontrollierte Sprache*) has captured interest of plenty of linguists engaged in linguistic research of technical texts and their typical structures. This version of the language is based on the specific textual models. Texts of this kind are simple in style, grammar and sentence structure and their vocab-

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ulary focuses on particular areas (without polysemy, homonymy or synonymy). Production of a controlled language text has to comply with well-defined rules. Production of texts is governed by certain patterns elaborated by some companies to ensure not only certain standard and image but also definiteness and quality of their communication tool, unified terminology and comprehensible formulations in documents. This is the evidence of professionalisation of technical texts as a form of communication. This trend results from the need to make transparent important information about products and production processes. Comprehension of technical data and guidelines increases level of skills and safety in handling technologies. The effort to simplify the terminology to make it more accessible and unify the communication between a producer, a product and a consumer resulted in uniformity and defining linguistic requirements for elaborating technical documents. Internal production technical documents as safety regulations, production guidelines etc. can be stated as an example of the aforementioned.

As far as instructional types of technical texts are concerned, their content and structure conform to specific requirements of a legal basis (Consumer Protection Act) and they are stipulated by directives and standards, e.g. in Germany "Richtlinie Technische Dokumentation" VDI 4500, "Erstellen von Anleitungen" DIN ENIEC 62079, "Gebrauchsanweisung für verbraucherrelevante Produkte" DIN V 66055 [4, p. 30].

Linguistic research of the technical language has developed over a period of time and apart from other things it concerned linguistic structures typical of a technical text:

From the diachronic perspective, primary phase of this research focused on the description of common specific features typical of a technical text in respective linguistic branches (morphology, lexis, stylistics). A German linguist Hoffman [5].

In his publication "Kommunikationsmittel Fachsprache" analysed and defined technical language from different perspectives: structural-systemic, lexical-terminological, functional linguistics, applied linguistics and translation. The Prague school of linguistics also conducted systematic research in stylistic distinction of a language inventory. The resulting theory of functional linguistics gave rise to further analysis of its applicability in the complex framework of technical languages.

The emphasis on the communication aspect of linguistic phenomena has moved the research of the technical language towards the search of prospective links between structural-systemic assessment of the language and socio-communicational effects of linguistic phenomena. Present linguistics tends to analyse the text not only as a mere process of linking words into certain syntactical and morphological relations. Presence of pragmatic aspect of the text helps create actual impact of linguistic discourse on the addressee. The role of pragmatics is to achieve certain impact or effect on the addressee by means of certain language utterances (intonation, phonology, morphology, or syntax) in certain situations [6].

Pragmatic aspect of a language utterance arises from the function of the language being an active communication tool, i.e. language utterances are used effectively in order to arouse interest of parties involved in the communication. It is thus a relation between an utterance and its user, or its meaning and effect. Assuming the language utterances used for exchanging information had no practical benefit, they would be meaningless.

Pragmatic analysis comprises both syntactic and semantic element. Pragmatics focuses on clarity and efficacy of linguistic and non-linguistic utterances with particular respect to methods and forms of conscious selection of these utterances in order to achieve certain communication purpose.

A technical text is understood, produced, translated or interpreted well only on condition that the communicators employ their technical and communicative competences. This means that they match their professional knowledge of the subject matter of the communication with their language mastery (terminology and typical linguistic structures) as well as with their interpretational skills. Concord of content, form and function is hence achieved.

Summing up the knowledge of morphology, lexicology and syntax and relating it to its function, we come to an assumption that typical characteristics of a technical text are such language utterances whose most significant features are exactness and definiteness. Frequent occurrence of nouns is another typical attribute of technical texts. It is closely linked with notional-terminological denominations (in German mostly in the form of compounds) and with the propensity for syntactic condensation.

As Findra points out, a technical text is typical of its "nominal character" being the grounds of its "abstractness and notional brevity" [2].

Definiteness and accuracy are enhanced by the occurrence of language utterances performing various functions, e.g. modifiers of nouns - genitive (height of girder, intersection of axes, etc.), present participle (drilling torque), or past participle (welded material).

Another specific attribute of a technical text is its objectivity and neutrality. Passive constructions are typical of English and German technical texts. Descriptive function, commonly expressed by relative clauses, is also an exemplary feature of technical texts.

Selection of language utterances is closely linked with the function of the text. As far as functional aspect is concerned, technical or scientific texts can define, classify, describe objects or actions, provide instructions, compare, review, assess or explain.

The most remarkable feature of a technical text is the lexical predominance of terminology. Emphasis of the lexical aspect of the technical language brought about detailed study of terminology (Hoffmann Kommunikationsmittel Fachsprache) [5]. This resulted in focusing the primary interest on the analysis of word-formation. Technical terms endow technical texts characteristic features of conceptuality, neutrality, definiteness and accuracy. Word-forma-

tion process also abides by certain structural models by means of which the following specific communication functions can be achieved:

- nominal, in order to denominate actions, mediators of actions, or properties of technical objects or quantities,
- descriptive, to describe properties of technical objects and phenomena etc.

The aim of this research was to gather frequently used model linguistic structures in Slovak, English and German technical texts whose common feature was pragmatic function. Based on this fact, they interrelated systemic and structural characteristics of technical texts with their function and impact on the addressee. By means of comparison of these model linguistic structures in several languages, valuable findings about technical texts as linguistic-pragmatic elements have been obtained.

Linguistic and pragmatic analysis of technical texts concentrated on the presence of word-formative, grammatical, syntactical structural models and their functions designated in this paper as nominal, descriptive and directive functions. The aforementioned functions attributed to the models certain word-formation processes.

2. Examples of certain types of structural models

Morphological structural models in technical texts

Morphology of the technical language distinguishes the process of constituting forms (Formbildung), namely formal representation of certain grammatical categories and word formation (Wortbildung) [7, p. 16].

1.1. Word-formation structural models

- with nominal function (resulting product is a noun)
 - a. denomination of activities or mediators (verbal nouns, nomina agentis, nomina instrumentalis)

infinitive German/English	Slovak	German	English
zvarat schweißen/ weld	zvaranie	das Schweißen	welding
	zvar	die Schweiß	weld
	zvarac	der Schweißer	welder
	zvaracka	die Schweißmaschine	welder

- b. denomination of properties of technical objects or quantities/parameters

adjective German/English	Slovak	German	English
dlhý/ lang/ long	dlzka	die Länge	length
siroky/ breit/ wide	sirka	die Breite	width
vysoky/ hoch/ high	vyska	die Höhe	height
hlboký/ tief/ deep	hlbka	die Tiefe	Depth
pevný/ fest/ strong	pevnost	die Festigkeit	strength

- with descriptive function (adjective as a result)

1. description of properties of technical objects

	Slovak	German	English
property	bezolovnatý	bleifrei	unleaded, lead-free
resistance	ohnovzdorný	feuerfest, feuersicher	fire-proof
	vzduchotesný	luftdicht	airtight, air-proof
ability	tvarovateľný	verformbar	shapable

1.2. Grammatical structural models

- with attributive function of nouns, the purpose of the language utterance is to provide more specific and accurate characteristics [7, p. 21].

Gram. form	Slovak	German	English
Genitive	rychlost lietadla	Geschwindigkeit des Flugzeuges	velocity of aircraft
Present participle	pohybujúci sa prvok	hin- und hergehendes Element	moving part

2. Syntactic structural models

These generally include sentence structures

- with directive function

Function	Slovak	German	English
Necessity/ obligation:	znecistený filter treba (ma sa) ihneď vycistiť.	Das schmutzige Filter ist sofort zu reinigen.	A dirty filter needs cleaning.
Possibility:	znecistený filter sa da ľahko vycistiť.	Das schmutzige Filter ist leicht zu reinigen.	A dirty filter is easy to clean.
Prohibition:	znecistený filter sa nesmie používať.	Das schmutzige Filter ist nicht zu benutzen.	A dirty filter must not be used.

- with imperative function

Function	Slovak	German	English
Imperative:	Dodržiavajte normy!	Halten Sie die Normen ein!	Keep the norms!
		Die Normen einhalten!	
Appeal:	Pozor! Doležite!	Achtung! Vorsicht! Wichtig!	Caution! Attention!

- with comparative function

Comparison	Slovak	German	English
properties	X je väčšie ako Y. Y je menšie ako X.	X ist größer als Y. Y ist kleiner als X.	X is greater than Y. Y is smaller than X.

measures	Cim je X vacsie, tym je mensie Y.	Je größer X ist, um so (desto) kleiner ist Y.	The greater X (is), the smaller Y (is).
conditions	Ak sa zvacsuje X, zmensuje sa Y	Vergößert sich X, so verkleinert sich Y.	If we increase X, Y decreases.0
conditional relations	So zvacsovanim X sa zmensuje Y.	Mit Vergößerung des X verkleinert sich das Y.	Increasing X will result in decreasing Y.

Technical texts not only vary in subject matter based on a particular professional area (mechanical engineering, power engineering, telecommunications, information technologies, civil engineering etc.) but also in the level of professional expertise which affects terminology density as well as sentence structure. The degree of professional expertise of a technical text is dependent on the target reader. Instructional technical texts designed for consumers of technical products ought to be simple, comprehensible and clear, supplemented by non-verbal textual elements like images, photographs, diagrams, tables, charts, etc. Latest information technologies enable us to use sound simulations, animated pictures, videos, etc. Safety cautions are guiding, bare, brief, urgent and comprehensible texts generally reinforced by warning signs (Inflammable! Poison! High voltage danger).

Technical texts designed for specialists or experts are more elaborated, saturated with technical terms, and have more complex sentence structure, which makes them less comprehensible to ordinary consumers/readers. Hoffmann [5, p. 33] made a division of technical texts according to the level of abstraction into scientific texts ranging from theoretical, experimental and applied science, and into technical texts of material production with lower level of abstraction and consumer technical texts with the lowest level of abstraction.

The incursion of technical language into everyday life is often felt by ordinary users as a communication hindrance as they

usually find technical language unfamiliar and incomprehensible. This applies to various types of texts, e.g. user manuals, composition of chemical substances, safety warnings etc. Therefore, technical information often includes images, photographs, diagrams etc. in order to reinforce perception of the technical text. Complex sentence structures and high terminology standard may be viewed as a barrier for a smooth communication. Understanding the structures of the technical language in relation to the function of the text leads to refining language competences and perceiving the technical text correctly.

Structural models may become useful tools for

- making the process of technical language teaching at universities more efficient in order to acquire more profound knowledge in the professional area
- improving skills of technical texts comprehension
- translating technical texts,
- production of technical texts in foreign languages.

Short technical texts such as instruction manuals or safety cautions accompany products on the market and in compliance with the regulations of the European Union they must be translated into several languages. Numerous international corporations and producers that sell and provide their products and services in Slovakia are also obliged to elaborate manuals or working instructions in foreign languages. Active knowledge of a foreign technical language is therefore a necessity. Many companies require sufficient proficiency of a technical language apart from their internal "controlled languages". "At present a growing number of international companies has brought about the demand for language learning. Sufficient command of a foreign language has become a prerequisite for a success on the labour market" [8, p. 242]. Structural models can enhance the process of mastering linguistic and technical competences in a foreign language for ordinary users as well as in a professional field.

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ON ONE CLASS OF THE INFINITE NON-ABELIAN GROUPS

We present some properties of one class of the infinite non-abelian groups. We deal with a generalization of the INH and KI groups. Our main results are Theorem 1, 2, 3 and Theorem 4.

Key Words and Phrases: a group, a commutator of group, a locally graded group, p -quasicyclic group, a direct and semidirect product of groups, an extension of the group.

The description of groups defined by the systems of their subgroups was first described in the papers by Chernikov, S. N. and Kurosh, A. G (RN – groups, [5]) Chernikov dealt with an extension of the direct product of the finite number of the quasicyclic groups by the finite abelian group ($\mathfrak{C}$ – groups, [1]), and with the infinite non-abelian groups whose arbitrary infinite subgroup is the normal subgroup of the whole group (INH – groups, [1]). Subbotin, I. J. studied the groups G whose every subgroup of the commutator G' is a normal subgroup of G (KI – groups, [6]). In this paper we describe the infinite non-abelian groups with the finite nodal subgroup.

We use the standard designations of terminology of the theory groups. For example: $M \times N$ the direct product of the groups M and N , $\sum_{i \in I} X_i$, the direct sum of the groups X_i for all $i \in I$,

$M \lambda N$ the semidirect product of the groups M and N , $M.N = \{mn; m \in M, n \in N\}$ the product of the groups M and N , G/A the factor group of G by A , $|G : N|$ the index of the subgroup N in a group G , $\langle a \rangle$ the cyclic group generated by one element a , $\langle a, b, c \rangle$ the group generated by the elements a, b, c , $H \triangleleft G$ H is normal in G or H is a normal subgroup of G , $G' = [G, G]$ the commutator of the group G , $Z(p^\infty) = \{x; x^{p^n} = 1, n = 1, 2, \dots\}$ the p -quasicyclic group, $Q_8 = \langle a, b; a^4 = b^4 = 1, a^{-1}ba = b^{-1} \rangle$ the quaternion group, $C_G(A)$ the centralizer of A in G , $C(G)$ the center of G .

A group G is a solvable group, if it has the solvable derived series $G > G' > G^{(2)} > \dots > G^{(n)} = \langle e \rangle$. A group G is called Dedekind group if every subgroup A of G is a normal subgroup of G . Hamiltonian group is called a non-abelian Dedekind group. A group G is called a locally graded group if every finitely generated non-trivial subgroup of G contains a proper subgroup of finite index ([1] p. 236). The subgroup A is called quasiceutral of the group G if each subgroup of A is the normal subgroup of G . If

a group G is an extension of the group H by the normal subgroup N of G , then $G/N \cong H$. If a group G is an extension of the quasicyclic group by the finite group, then a group G is called an almost quasicyclic group.

Definition 1. An infinite non-abelian G is said to be an *IAN* group if there exists a subgroup A of G such that every infinite subgroup of A and every infinite subgroup of G contains A is a normal subgroup of G . The subgroup A is called a nodal subgroup. If A is an abelian subgroup, then G is *IANA* group.

Proposition 1. [[1], T. 6.10]. The class a solvable *INH* groups formed from the infinite Hamiltonian groups and the non-abelian non-Hamiltonian groups that are the finite extensions of the quasicyclic subgroups by the finite abelian and the finite Hamiltonian groups.

Proposition 2. [[7], T. 5.8]. Let F be a group and let $X = \{x_i; i \in I\} \neq \emptyset$ be a subset of F such that $\langle x_i \rangle$ an infinite cyclic group for all x_i from X . If $F = \sum_{i \in I} \langle x_i \rangle$ is the direct sum of the cyclic groups $\langle x_i \rangle$ for every $i \in I$, then F is free abelian group with the set X of the free generators.

Lemma 1. If G is *IAN* group with a finite nodal subgroup A , then G/A is an abelian group or *INH* group.

Proof. If G/A is an abelian group, then Lemma 1 is valid. Let G/A be non-abelian group and let B/A be an arbitrary infinite subgroup of G/A . Evidently, there exist $B \triangleleft G$ and $B/A \triangleleft G/A$. Thus G/A is *INH* group.

Lemma 2. If G is an infinite group with a finite commutator G' of the group G , then G is *IAN* group with a finite nodal subgroup G' .

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Proof.

If put $A = G'$, evidently, then G is IAN group with a finite nodal subgroup.

Lemma 3. Let G be IAN group with a nodal subgroup A . If a nodal subgroup A contains the elements of the infinite orders, then A is an abelian quasicentral subgroup of group G .

Proof. By Proposition 2 A is an abelian group. Let B be an arbitrary subgroup of the group A . If B is an infinite subgroup, then B is a normal subgroup of G .

Let B be a finite subgroup. By assumption, the group A contains the element x of the infinite order, A is an abelian group. If $B \langle x \rangle \cong B \times \langle x \rangle$, by definition IAN groups $B \times \langle x \rangle \triangleleft G$ and furthermore $B \triangleleft G$. Thus A is an abelian quasicentral subgroup of group G . Lemma is proved.

Lemma 4. Let G be a locally graded IAN group with a nodal subgroup A . If there exists a subgroup A that is not a normal subgroup of G , then A is a finite group, or A is an extension of the quasicyclic subgroup by a finite Dedekind group.

Proof. Let G be IAN group with a nodal subgroup A , $A_1 \triangleleft A$, A_1 is a non-normal subgroup in G . Evidently, $A_1 \neq \langle e \rangle$, A_1 is a finite subgroup. By Lemma 3 A is a periodic group. If A is a finite group, then lemma is valid. Let A be an infinite periodic subgroup. We consider two possible cases: A is non ψ -group, or A is ψ -group.

Let A be non ψ -group. Suppose that there exists the subgroup A_2 of A that $A_2 = A_3 \times A_4$, $A_2 \cap A_1 = \langle e \rangle$ and A_3, A_4 are the infinite groups. By Definition 1 $A_3 \triangleleft G$, $A_3 \times A_1 \triangleleft G$, $A_4 \triangleleft G$, $A_4 \times A_1 \triangleleft G$. Evidently, $(A_3 \times A_1) \cap (A_4 \times A_1) = A_1$ and, furthermore, $A_1 \triangleleft G$. It is contradiction. Thus, A is not non ψ -group.

Let A be ψ -group. Denote $A = R.B$, R is the direct product of the finite number of the quasicyclic groups, R is a divisible group, B is the finite group, $B \neq \langle e \rangle$. Therefore, A_1 is not a non-normal subgroup of G . we assume that there exists a cyclic subgroup $\langle a \rangle$ of A_1 non-normal in G , and also $R \cap \langle a \rangle = \langle t \rangle$. Since R is a divisible group there exists a quasicyclic subgroup R_1 of R and, furthermore, R_1 contains the subgroup $\langle t \rangle$. Put $R = R_1 \times R_2$ where R_2 is an infinite subgroup of A , or $R_2 = \langle e \rangle$. If R_2 is an infinite subgroup of A , by Definition 1 $R_2 \triangleleft G$ and, furthermore, $(R_2 \lambda \langle a \rangle) \triangleleft G$, $R_1 \triangleleft G$, $(R_1 \langle a \rangle) \triangleleft G$. Evidently, $(R_2 \lambda \langle a \rangle) \cap (R_1 \langle a \rangle) = \langle a \rangle$ and $\langle a \rangle \triangleleft G$. It is contradiction. Then $R_2 = \langle e \rangle$, $R = R_1$ is quasicyclic group, and moreover, $A/R \cong B$ is a finite Dedekind group. Thus A is an extension of the quasicyclic subgroup by the finite Dedekind group. Lemma is proved.

Theorem 1. If G is a locally graded IAN group with a nodal subgroup A , then subgroup A belongs to one of the types:

1. A is a finite subgroup of G .
2. A is an extension of the quasicyclic subgroup by a finite Dedekind group, the commutator G' is an infinite group.

3. A is an infinite quasicentral periodic subgroup of G ,
4. A is a quasicentral non-periodic abelian subgroup of G .

Proof. Let A be a non-quasicentral subgroup of G . By Lemma 4 the subgroup A of G belongs to one of type 1 or 2 of this theorem.

Let A be a quasicentral subgroup of G . By Lemma 3 the subgroup A of G belongs to one of type 3 or 4 of this theorem. Theorem is proved.

By Theorem 1 and definition $IANA$ groups the next corollary follows.

Corollary 1. If G is a locally graded $IANA$ group with a nodal subgroup A , then subgroup A belongs to one of the types:

1. A is a finite abelian subgroup of G .
2. $A = Z(p^\infty) \times B$, B is a finite group.
3. A is an infinite quasicentral periodic abelian subgroup of G .
4. A is a quasicentral nonperiodic abelian subgroup of G .

Theorem 2. G - LAN groups with a finite nodal subgroup are the groups belonging to one of the types:

1. G is an infinite group, G is an extension of the finite subgroup by Dedekind group,
2. G is an extension of the finite normal subgroup by an infinite non-solvable group whose every infinite subgroup is normal in G .
3. $G = R.H$, R is a quasicyclic group contained in G' , H is a finite group contained in a normal subgroup N of G so that H/N is Dedekind group.

Proof. Let G be IAN group with a finite nodal subgroup A . If G/A is Dedekind group, then G is of type 1. If G/A is non-Dedekind group, by Lemma 1 G/A is non-Hamiltonian INH group. If G/A is a non-solvable group, then G is of type 2.

If G/A is a solvable group by Proposition 1 $G/A = (D/A).(H/A)$ where $D/A \triangleleft G/A$, D/A is a quasicyclic group, H/A is such a finite subgroup of G that the factor group $H/A/(D/A \cap H/A)$ is Dedekind group. Denote $G = D.H$, where $D \triangleleft G$, H is a finite group, and $A \leq D \cap H$. If G' is a finite group, then G/G' is an infinite group. By Lemma 2 G is a group of type 1.

Let G' be an infinite group. Assuming that D/A is a quasicyclic group, A is a finite group. Denote $D = A.C$ where $C = C_D(A)$ is a centralizer of A in D . Consequently, $C = (C_G(A) \cap D) \triangleleft G$, moreover $C \cap A \leq C(A)$. Thus, C is a central extension of the finite group by the quasicyclic group. Then D is an extension of the quasicyclic subgroup R by the finite group. Furthermore, $D = R.A$, $R \triangleleft G$ and $G = R.H$. Since G' is an infinite group, evidently $R \leq G'$. Let $N/A = D/A \cap H/A$ be the subgroup of G/A . By Isomorphism Theorem $(G/A)/(N/A) \cong G/N$, $N \triangleleft G$ and H/N is Dedekind group. Thus G is a group of type 3.

Conversely, let G be the group belonging to one of types 1 to 3. We shall prove that G is group with a finite nodal subgroup. Let the group G be of type 1. Then G is an extension of the finite sub-

group N by an infinite Dedekind group. Thus the commutator of the group G/N is a finite group, evidently the commutator of the group G is a finite group too. By Lemma 2 G is group with a finite nodal subgroup.

Let G be the group of type 2 or 3. Suppose that there exists a finite normal subgroup N of the group G so that G/N is non Dedekind group. Put $N = A$. Let B be an arbitrary infinite subgroup of G containing A . Then $B/A \triangleleft G/A$ implies $B \triangleleft G$. Since A is a finite group, evidently its every infinite subgroup is normal of G . Thus the groups of type 2 or 3 are IAN groups with a finite nodal subgroup. Theorem is proved.

Corollary 2. The locally graded IAN groups with a finite nodal subgroup are the groups to one of type 1 or 3 of Theorem 2.

Proof. If G is an locally graded IAN group with a finite nodal subgroup A , then G is the group to one of type 1 to 3 of Theorem 2. If G is the group to one of types 1 or 3 of Theorem 2, then Corollary 2 is valid. Prove that G is not the group of type 2 of Theorem 2. Let G be the group of type 2 of Theorem 2, then G/A is an infinite non-solvable INH group. If A is a finite group, and G locally graded group, evidently then G/A is a locally graded non-solvable INH group. It is contradiction. Thus G is not the group of type 2 of Theorem 2.

Corollary 3. The locally graded IAN group with a finite solvable nodal subgroup is the solvable group belonging to one of types 1 or 3 of Theorem 2.

Proof. Let G be an investigated group, A is its finite solvable subgroup. By Corollary 2 G/A is the group to one of types 1 or 3 of Theorem 2. Evidently, then G/A is the solvable group, by assumption A is the solvable subgroup. This implies that G is the solvable group.

Theorem 3. The locally graded $IANA$ group with a finite nodal subgroup is the solvable group of degree less or equal to number 3.

Proof. If G/A and A are solvable groups, then G is the solvable group and $(G/A)'$ is abelian group. Using this fact it follows that $G^{(2)}$ is abelian group and $G^{(3)} = \langle e \rangle$. Theorem is proved.

Theorem 4. The locally graded $IANA$ groups with a finite nodal subgroup are the groups belonging to one of the types:

1. G is an extension of the finite normal abelian subgroup N by Dedekind group.
2. G is an almost quasicyclic group, G' is an almost quasicyclic abelian group.
3. $G = R.H$, R is a p -quasicyclic group, $R \triangleleft G$, H is a finite group containing a normal subgroup N of G so that H/N is Hamiltonian group, $R.N$ is abelian group, the commutator H' is non-abelian group.

Proof. Let G be locally graded $IANA$ groups with a finite nodal subgroup. By Theorem 3 G is the solvable group. If G/A is abelian group, then G is the group of type 1 of this theorem.

Let G/A be non-abelian group. By Lemma 1 G/A is INH group. By Proposition 1 G/A is Hamiltonian group or an extension of the quasicyclic subgroup by the finite Dedekind group. If G/A is Hamiltonian group, then G is the group of type 1 of this theorem.

Let G/A be an extension of the quasicyclic subgroup B/A by the finite Dedekind group. We know that A is a finite abelian group, thus $|B : C_B(A)| < \infty$ and $A \leq C_B(A)$. If $A \leq C_B(A)$ and B/A is a quasicyclic group which does not contain the proper subgroup of the finite index, then $C_B(A) = B$ and thus $A \leq C_B$. It follows that B is a central extension of the finite abelian group A by the quasicyclic group (B is an almost quasicyclic group). Since R is a quasicyclic subgroup of B and a characteristic subgroup of B , thus R is a normal subgroup of G . By Isomorphism Theorem $(G/A)/(B/A) \cong G/B$ and furthermore G/B is finite Dedekind group. We consider two possible cases, G/B is an abelian group or Hamiltonian group.

Let G/B be an abelian group. Evidently, the commutator $G' \leq B$. If G' is a finite group, then G is the group of type 1 of this theorem.

If G' is an infinite group, evidently $G' \leq B$, then G and G' are almost quasicyclic groups. Thus G is the group of type 2 of this theorem.

Let G/B be Hamiltonian group. Evidently, G is an extension of the quasicyclic group R by the finite group. Denoting $G = R.H$, H is a finite group, consequently $N = B \cap H$, $B = R.N$, this implies $G/B \cong H/N$. Thus H/N is finite Hamiltonian group.

If G' is a finite group, then G is the group of type 1 of this theorem. If G' is an infinite group, then G is the group of type 2 of this theorem.

Let G' be an infinite non-abelian group. Put $G = R.H$, where R is a normal subgroup of G . It is well-known that $C_G(R) \geq G$, $G' = R'.H'$, $[R, H] \leq R.H'$, and $[R.H'] = \langle e \rangle$. From the product of the groups M and N , where M is the central group and N is abelian group and $G' \leq R.H'$, it follows that H' is nonabelian group. Thus G is the group of type 3 of the Theorem 4.

Conversely, let G be an infinite group one of types 1 to 3. If G is one of type 1 or 3, then we put $A = N$. If G is of type 2 we put $G' = R \times D$ which is the direct product of a quasicyclic group R and a finite group D . If A is the subgroup of G generated by the elements of G' whose orders are divisors of the order of D , then A is abelian group and $D \leq A$.

Let G be the group of type 1. Then G/A is Dedekind, there exists B/A an arbitrary normal subgroup of G/A . Consequently, $B \triangleleft G$.

Let G be the group of type 2. We have $G' = R \times D = R.A$. It follows that G/A is an extension of the quasicyclic group $G'/A = R.A/A$ by the finite abelian group. Thus B/A is an arbitrary normal subgroup in G/A . Consequently, $B \triangleleft G$.

Let G be the group of type 3. In that case G/A is an extension of the quasicyclic group $R.A/A$ by the finite Hamiltonian group

H/A . Evidently, $B/A \triangleleft G$ implies $B \triangleleft G$. If G is the group one of types 1 to 3 this theorem, then G is $IANA$ group with a finite nodal subgroup A . Theorem is proved.

Remark. The class of the infinite solvable $IANA$ groups contains the class of solvable INH and the class KI groups with the finite commutator.

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Jan Stebila *

NEW FORMS OF NATURAL SCIENCES EDUCATION IN THE CONTEXT OF LOWER SECONDARY EDUCATION IN THE SLOVAK REPUBLIC

In our country, there is no debate on road safety education and convenience of the use of computers to carry out this issue. We are aware of the vastness and complexity of the issue and we know that we can and we should explore it in great detail. It is interesting for us to know if pupils achieve better learning results in the first three areas of Niemierko taxonomy (remembering, understanding, specific transfer) when multimedia teaching aid (other than MTA) is used in teaching, and if pupils learn more actively in the classroom, where MTA is used in comparison to teaching applying the traditional teaching methods.

1. Introduction

Currently, there are several methods and techniques, according to which it is considered to what extent the work of a teacher was effective in the teaching process. For example, time of active work of pupils in the teaching process is measured. The effectiveness tends to be considered on the basis of knowledge or a change of opinions, attitudes and value orientation. Neither of these methods can be said to be a really optimal indicator of reality, since the results, which are considered, may affect a large number of factors and none of these methods considers them comprehensively [7].

Based on the foregoing, we state that the consideration of the effectiveness of the teaching process currently more or less depends on the ability of the teacher, i. e. to what extent the teacher uses his or her processes, methods and new teaching aids at work, etc.

Although we embarked on implementing the multiannual educational research, experience was more important than the gathered numbers and output to us. The experience was supposed to confirm that MTA is effective and helps pupils when learning the issue of road safety education [8, 9].

2. Search of innovative approaches and forms of teaching in a lower secondary education

Our long-term interest was, and still is, to teach pupils the elements of RSE. New innovative approaches allow us to use multimedia and computers in teaching. We tried to profit from our skills, knowledge and potential when searching and creating new effective

teaching aids, which would fully replace their momentary deficit for the issue, and make the education more effective. Streamlining of teaching is a very difficult and long process and it cannot be solved comprehensively. When creating new multimedia teaching aids, we focused mainly on RSE issues where computers are used as means for teacher's work, but also for pupils- traffic participants. The issues are, in particular, skills to use a bicycle in traffic safely, basis of its maintenance and repair, traffic rules in terms of a cyclist, traffic signs, etc. Handling these applications is the basic "equipment" of today's human society [8, 9].

We realize that the use of information technology and computers in the teaching process also brings certain disadvantages and complications, but we believe that when they are used properly, they are indispensable means of humanization of teaching and they significantly contribute to the creativity of pupils. The teacher is the one who must be aware that the computer is a means that can mediate information to the pupils, but emotions and love can be expressed only by the teacher [5, 6].

In order to have effective education that would equally develop cognitive and affective area of a personality of the pupil, it is necessary, except for computer technology, to use various methods, contents and forms in teaching. There is no content that could be mediated without methods and there is no mediation without a medium (teaching aid). For these reasons, when we were creating and searching for effective procedures of using the new teaching aid, we tried to use, except for computer technology, synergies of other methods and procedures, particularly in the area of project and problem teaching. The role of MTA is to satisfy the pupil's needs in cognitive but also in affective areas [10].

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3. Research of the impact of MTA on development of RSE at Slovak schools

This chapter aims to present the current results of the research that we gathered in the research of implementation of MTA into teaching. It ought to highlight the merits of using MTA in teaching road safety education. We chose the method of experimental verification for the purposes of this research.

Subject of Research

The research was carried out among pupils of the 2nd level of primary school. The teaching of technical education in selected thematic areas is supported by MTA that we designed for the field of road safety education. There is an optimum support of information and communication technologies.

Aims of Research

The aim was to verify the success of the use of MTA in real conditions of the selected schools having technical education, where work with computers is also used. We examined the knowledge of the first three levels of educational objectives of Niemierko taxonomy and active learning of pupils.

A natural educational experiment was performed within the research. Teaching was carried out in experimental classrooms (MTA was used in the teaching process) and control classrooms, where the teaching was carried out in a traditional way without using MTA.

We were especially interested in those educational features which have the highest priority in relation to creative-humanistic teaching in the theory.

When dealing with the issue of implementing road safety education of pupils at primary schools, the following objective was set within the educational research: To find out whether it is possible to develop cognitive abilities of a pupil from road safety education for pupils of the 6th year of primary schools with the use of the suggested MTA when teaching technical education.

Research Sample

The basic set, suitable for our research, were pupils of the 6th year of the 2nd level of primary schools in the Slovak Republic. We can consider the results of the population of pupils of the 6th year in the Slovak Republic to be normally distributed. That is why we can process data as a selection of the normal distribution in the research. In terms of external validity of the research, we performed the sampling selection by a stratified selection. The sample was made of 214 pupils of the 6th year from five primary schools in the Slovak Republic. To be able to objectively determine whether our MTA (independent variable) affects the level of knowledge of road safety education of pupils of the 6th year of primary schools in technical education, we included two groups of respondents in the experiment: the control group and the experimental group. The control and experimental groups were always formed by the entire class. The control group consisted of 107 pupils. 107 pupils were also in the experimental group. Table 1 shows various numbers in

the sets of different schools. We purposefully marked all control subgroups as one control group CON and all the experimental subgroups are identified as one experimental group EXP.

The Overall Summary of the Selection of Pupils into Groups in the Educational Research

Table 1

Number of selected classes of the 6 th year of the 2 nd level of primary schools	10	214 pupils
Number of groups taking part in the educational research	2	CONTROL and EXPERIMENTAL
Number of experimental subgroups	5	a given number of pupils in every subgroup
Number of control subgroups	5	a given number of pupils in every subgroup
Experimental group EXP • experimental subgroup A1 • experimental subgroup A2 • experimental subgroup A3 • experimental subgroup A4 • experimental subgroup A5	107 pupils 22 pupils 24 pupils 25 pupils 24 pupils 12	
Control group CON • control subgroup B1 • control subgroup B2 • control subgroup B3 • control subgroup B4 • control subgroup B5	107 pupils 22 pupils 24 pupils 25 pupils 24 pupils 12	

4. Performance of the Experiment

We started the experiment at primary schools in both groups simultaneously at the beginning of February 2008. Both groups followed the same schedule and content. The only difference in the teaching of both experimental and control groups (EXP, CON) was the application of the verified MTA. This teaching aid was used only in the experimental group, while in the control group the teaching was conducted in a standard way, without the use of this multimedia teaching aid.

During the performance of the experiment, pupils did not know that they are in the experimental group. Thus we were able to ensure the confidentiality against undesirable external influences, and we prevented a formation of intervening variable.

In the way of the above described selection procedure, we developed an assumption to a valid determination of the impact of the experimental operation whereas the intervening variables remained constant during the experiment. The selection procedure, however, could not affect certain effects that could distort research results. Among such effects we included the impact of gender, family ownership of a computer, intelligence, previous experience, etc. Their

potential impacts on the results of the research are also considered to be constant.

Each pupil was informed that he or she would have to take an obligatory didactic final test, which could not be possible to implement in an alternative day. We believe that due to this requirement, the participation in the final didactic test was of 100%.

The final didactic test was carried out after the thematic unit of road safety education named *Machines and Mechanisms*. Both groups were tested in their school. All pupils had equal working conditions and the same instructions. The final didactic test for each student consisted of 18 questions. We chose them from the bank of tasks after the agreement with teachers. Pupils had to give or choose the answers. The questions were identical for all pupils. The tests differed only in sequence. Their contents were same. To reduce and minimize cheating, we prepared two versions of the final didactic test. The time limit for the test was 22 minutes. After this time limit, it was not possible to complete the test. Blank questions were evaluated as false, i.e. 0 points. A pupil could get a maximum of 33 points for the whole test, while for each correctly answered question there were 1, 2 or 3 points.

After finishing the test, an anonymous filling in of questionnaires took place. The standardized questionnaire AUS was distributed to pupils. It diagnoses the active learning of pupils during lessons from their answers concerning the teaching of a certain subject. The administration of the questionnaire takes approximately 10 minutes. The total score of the questionnaire corresponds to the process of active learning, which is diagnosed in the questionnaire in five areas:

- PLACE of learning (at home, at school),
- FREQUENCY of situations in which active learning of pupils takes place during a lesson,
- TIME of active learning during a lesson,
- FORM of active learning of pupils during a lesson,
- FEEDBACK on learning.

We considered the inclusion of the standardized questionnaire for a long time, but finally we used it for measuring. However, we think that a more appropriate method for diagnosing this problem would be the method of observation and dialogic methods. The pedagogic experiment took place during lessons in several schools of Slovak towns. For that reason, we could not play the role of the observer.

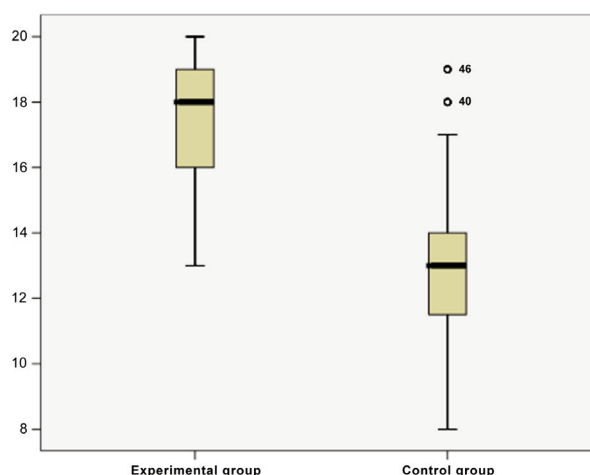
Filling in the questionnaire took place in the classrooms, which have a classic in-line arrangement of desks. Pupils were sitting in the way they could not cheat.

During the performance of the pedagogic experiment we did not mark any significant effects that could undermine the measured results and the main objective of the research. After the teaching experiment, we collected the obtained data and subjected them to statistical and qualitative analysis.

5. Statistical Processing and Analysis of the Collected Data

A standardized questionnaire AUS (Active Learning at School) was used to determine the degree of active learning of pupils. The results of the measurements of the variable ACT were analyzed by the methods of descriptive statistics. The results are comprehensively shown in the following tables and graphs.

The values which are processed in table and graph 1 show the differences in the degree of active learning of pupils during lessons of technical education when MTA was used in the experimental and control groups.

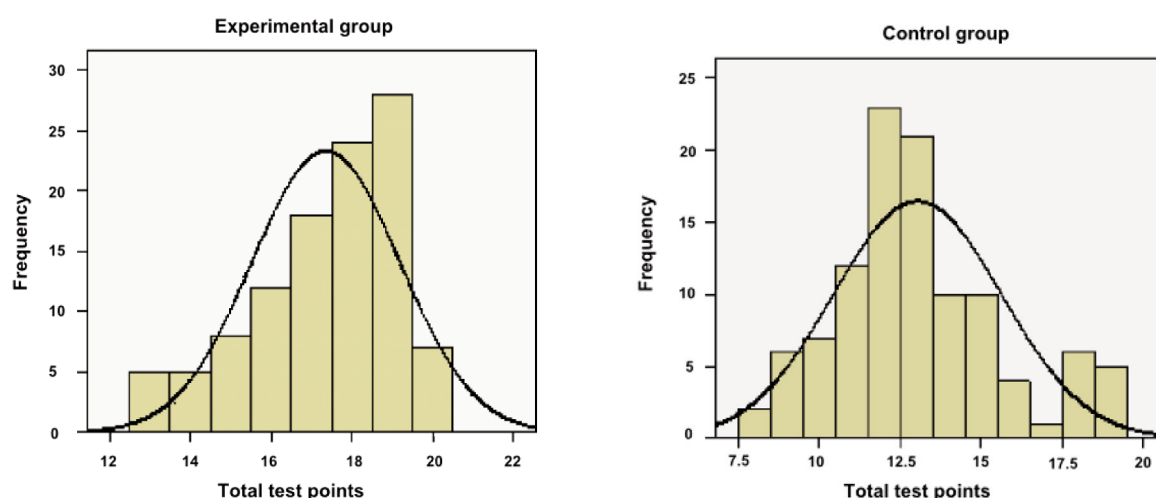


Graph 1 the Box Plot for Hypothesis H

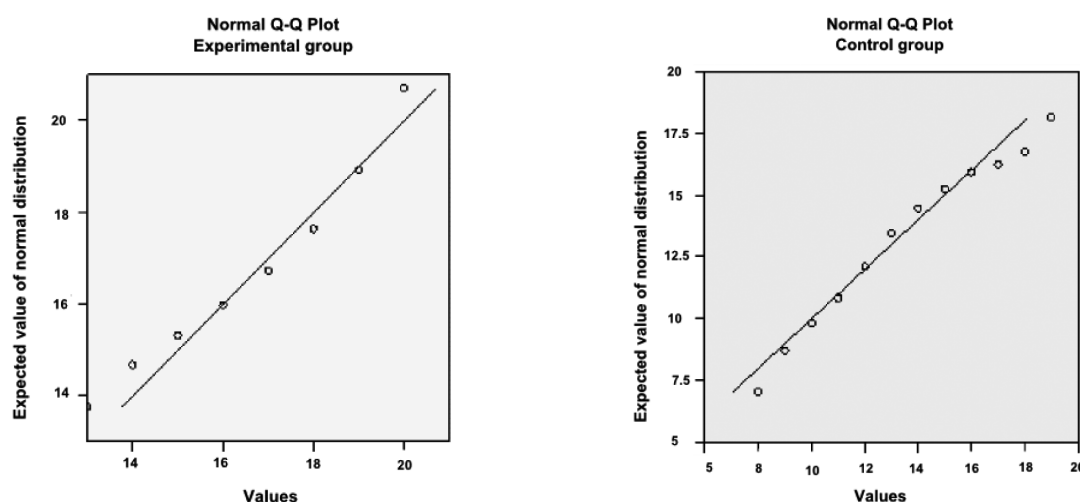
Graph 1 shows that pupils reflected the degree of active learning in a different way. Pupils perceived a very good degree of active learning during lessons in the experimental group. The measured median value shows that the teacher using MTA created favorable conditions for active learning of the pupils. The teacher regularly prepared appropriate learning tasks and activities with the feedback of learning. Pupils were active during the lessons, they learned the subject matter mostly in school and consequently, they did not need to learn at home.

Lower degree of active learning during the lessons was perceived by pupils in the control group. The measured median values indicate that the teacher using methods and teaching aids (other than MTA) did not create very favorable conditions for active learning during the lessons. Pupils could collaborate in groups during the lessons, but the active learning with a feedback of a good quality, due to lack of time, was rare. The activity during the lesson was mostly performed by the teacher. Pupils were rather passive, as observers, during the lessons.

These research results show differences in the degree of learning during lessons of pupils from the experimental and control



Graph 2 the Histogram of the Frequency of the Variable ACT in Experimental and Control Groups



Graph 3 the Approximation of the Distribution of the Variable ACT Frequency to a Normal Distribution

groups. The assumption of the research on the differences in the degree of active learning of pupils in the classroom turned out to be true and confirmed for the sample. The subsequent inductive methods confirmed that assumptions on the differences of the degree of active learning of pupils are applied with the probability of 95%.

Pupils from the control and experimental groups achieved in the research different scores and they were placed in a variety of qualitative intervals within the different scales. In order to generalize the argument as a basic set, we performed an inductive statistical analyze. Based on the analysis of the characteristics of both groups (CON, EXP) we can confirm that it is reasonable to test the hypothesis H which says that pupils who are taught with MTA will learn during the lessons more actively than pupils who are taught traditionally without using MTA. This means that we will test the hypothesis:

H₀: The median value (estimated by the arithmetical average) of experimental and control group is the same.

The implemented Leven F-test unambiguously declares that we reject the hypothesis H₀ of equal scatters ($p = 0.017 < 0.05$). Because of this, we take into account the results from the bottom line (the output of the statistical system SPSS for two-sided alternative, where p (T-test) = 0.061 and p (T-test) = 0.008 (for two-sided alternative), thus we reject the hypothesis H₀. We summarily show the outputs from the system SPSS of the T-test in the table.

Statistical testing using the T-test confirmed the significance of differences in the performance of experimental group and control group, which is caused by the use of MTA.

The results show that MTA affects the active learning of pupils. The measured value confirmed the test of the hypothesis on the

The T-test with Two Choices on the Equality of the Median Values for Hypothesis H

Table 4

	Leven F-test		T- test on the Equality of the Median Values						
	F	P-value of F-test	T	df	P-value two-sided alternative	Difference of Median Values	Standard Error of the Difference of Median Values	95% konf. Interval for the Scatter	
								Down	Upper
Equality of scatters	5.749	0.017	14.082	212	0.000	4.31776	0.3066	3.7133	4.9222
Inequality of scatters	-	-	14.082	190.596	0.000	4.31776	0.3066	3.7129	4.9226

significance of differences of the arithmetical averages of the score of the dependent variable ACT (Table 4).

The T-test confirmed that the difference of averages of the total score from the standardized questionnaire AUS (Active Learning at School) of the dependent variable ACT was not random, but it was significant on the level of significance 0.05.

Based on the facts, we can state that if the teacher taught with the same MTA in the control group as he or she had taught in the experimental group, then pupils would reflect, with greater probability than 95%, the degree of the active learning during lessons in the same way and as pupils from the experimental group.

The research results confirm the assumptions made in the working hypothesis H. We argued that pupils from the experimental group, where MTA was used, would learn more actively during the lessons than pupils from the control group, where teacher did not use the MTA.

The hypothesis was confirmed, and its validity can be generalized to a basic set of pupils who took part in the research.

6. Evaluation of the Research and Prediction of the Application of MTA in Teaching

The purpose and the main aim of the pedagogic experiment were to practically verify the success of MTA in conditions of primary schools. We assumed that the use of our multimedia teaching aid in teaching Technical Education on the 2nd level of primary

schools would significantly affect the level of knowledge of pupils from the issue of road safety education, particularly in terms of performing, remembering, understanding, specific transfer and active learning of pupils.

The validity of the working hypotheses on the level of significance 0.05 is shown in Table 5. We used a non-parametrical test on the compatibility of median values for verifying the main hypothesis.

It is possible to say that from the statistical analyses and conclusions of testing partial hypotheses, the initial hypothesis is confirmed and true on the chosen level of significance 0.05 and in the given conditions. The research on the application of the presented MTA and its methodology on the level of significance 0.05 allows us to state that:

- Pupils who were taught with MTA achieved at the end of the experimental teaching a better performance in the didactic test in the area of specific transfer, understanding and remembering than pupils who were taught traditionally.
- Pupils who were taught with MTA learnt more actively during the lessons than pupils who were taught traditionally.

Teaching with the help of MTA requires an intensive work with modern technologies at the beginning and it is connected with a certain risk that is always present when using computer techniques. Working with the aid gives much more pleasure from teaching and learning. Moreover, the total effectiveness of the learning surpasses traditional forms of education in the subject when using the aid in a right way. MTA designed in this way gives a chance for a greater discussion among pupils in the classroom, teachers and pupils, teachers of technical education and teachers of different subjects.

We are convinced that MTA fully uses the potential of current modern information and telecommunication technologies. The teaching aid integrates current principles of creative and academic education. When we use it in the right way, it can make the process of education significantly simpler and more effective. It helps to satisfy the needs of pupils in the cognitive but also in the affective area that have a key importance in the education of the youth in the long-term point of view.

Information from the experiment but also our experience from using the teaching aid enable us to suggest that MTA has a great chance to become a standard in education with computers in the

The Summary of the Verification of the Hypotheses

Table 5

Hypothesis	Method for Obtaining the Facts	Validity of the Hypothesis	Examined Variable
H1	DT - final	Valid	Performance in the Cognitive Area
H2	DT - final	Valid	Specific Transfer
H3	DT - final	Valid	Understanding
H4	Standardized Questionnaire AUS	Valid	Active Learning

future. The teaching aid of this kind of education has not been elaborated up to now. We hope that this aid will help to standardize the tool in the field of education.

We would like to continue in the pending research in the future. We focus on the possibility of application of MTA in the

educational process not only within technical education but also in the subjects where the issue of RSE is included in the content of the subjects at schools of different Slovak regions.

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Marta Lackova *

APPLICATION OF DETERMINERS IN PHRASEOLOGICAL UNITS CONTAINING NAMES OF HUMAN BODY PARTS

The article deals with formal expressive means of the category of determination which are applied in phraseological units of the English language containing names of human body parts (nouns ear, eye, face, foot, hand, head, heart are the focus of our attention). At first, the article provides a brief introduction into the linguistic area of determination. Three types of determiners (predeterminers, central determiners, postdeterminers) are classified in order to provide background information for further research. Moreover, general rules dealing with the use of articles with reference to body parts are introduced. The above mentioned types of determiners find their realization also within the framework of the analysed phraseological units. Possessive pronouns, the definite, indefinite and zero articles represent the most spread types of determiners in the studied area.

Key words: phraseological unit, determination, determiner, article, pronoun.

1. Introduction

Linguistic determination is an analogical term with the scientific term determinism. Determination originates as a way of relations arrangement between communication activities and language systems. From the functional point of view, determination is to a certain level close to quantification.

A determinative structure is an expression form of functional and semantic meanings of language area informational surroundings. Determinative structures find their potential in a language system; they are activated during language operation and they may be directly expressed in a text. These aspects contribute to the fact that the category of determination belongs to evaluative and contextual categories [5].

The category of determination represents one of the most complex noun categories in languages of the world. Meanings which are transferred via the category are crucial for successful communication acts. Owing to this, the category has acquired the position of a universal semantic category and of a universal element of interpretation in most languages.

In individual languages there are numerous semantic elements that find their realization in the category of determination, but most generally, it is possible to state that the category is based on two basic semantic opposition systems: definite/indefinite, specific/general.

The category of determination has not acquired a grammatical status in all languages. Therefore the category is divided into gram-

matized and nongrammatized from the point of view of its formal expression.

In the frame of Germanic languages we talk about grammaticalized category of determination since they possess a system of formal expressive means on the surface linguistic structure in order to express the above mentioned meanings of the category.

We will base our research on the following classification of formal expressive means of the category of determination in the English language; in fact, we distinguish three basic types of determiners [6]:

1. predeterminers;
2. central determiners;
3. postdeterminers.

Predeterminers – *all, both, half, double, three times, one third, what, such* – appear before central determiners in a noun phrase.

Articles – the definite article *the*, the indefinite article *a, an*, the zero article – represent the most typical central determiners. Except for the articles, central determiners include:

- possessive pronouns as determiners *my, our, your, his, her, its, their*;
- relative determiners *whose* and *which*;
- wh-determiners in *-ever*, e.g. *whichever*;
- interrogative determiners *what, which, whose*;
- assertive determiner *some*, nonassertive determiner *any* and negative determiner *no*;
- quantitative determiner *enough*;
- demonstrative determiners *this, that, these, those*;

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- universal determiners *every* and *each*;
- nonassertive determiners *either* and negative determiner *neither*.

Postdeterminers follow predeterminers and central determiners and they precede other modifying elements of the noun phrase. Postdeterminers include:

- cardinal numerals: *one, hundred*;
- ordinal numerals: *the second, the twentieth* + expressions *next, last, past, other, another, additional, further*;
- closed-class of quantifiers: *few, little, many, several, much, plenty of, a lot of, lots of*;
- open-class of quantifiers: *a number of, a deal of, a quantity of, an amount of*.

2. The use of determiners with reference to body parts

From the most general point of view, the nouns in our focus – *ear, eye, face, foot, hand, head, heart* – are countable nouns which means that they are preceded by the indefinite article in singular and the zero article is acceptable only in plural. The definite article may also be used to mark the noun as definite.

It is also necessary to take into account specific issues connected with the use of determiners in this context [1].

The definite article *the* is often used instead of possessive pronouns when referring to parts of the body and clothes and following a preposition: *He pulled her by the hair/the sleeve. He shook my hand.*

There is a similar use of *the* in other impersonal contexts where the possessor is either irrelevant or already clear: *You will feel much better if you keep the back straight when sitting.*

It is not possible to use *the* (the possessive pronoun must be used) if the body part does not refer to what is denoted by the direct object: *She plays tennis with her left hand. She plays tennis with the left hand.* (she is left-handed)

The use of *the* is preferred when we describe unpleasant conditions of the body. Only verbs which can take the personal direct object without the prepositional phrase can occur in this construction: *He turned red in the face when he heard the news.*

The definite article *the* is sometimes used instead of possessives in a masculine style of speech [2]: *How is the leg?* (talking about an injury)

3. The use of determiners with reference to phraseological units containing body parts names

The following formal expressive means of the category of determination are applied in phraseological units containing the noun ear [3], [4]:

1. the quantifier *all* – *be all ears*;
2. the cardinal numeral *one* – *go in through one ear and out of the other*;
3. the zero article
 - a) singular – after a preposition – *play sth by ear, from ear to ear*;
 - b) plural – *fall on deaf ears; ears are flapping; have good ears*;
4. possessive pronouns – *come to your ears; get your ears; lend your ears to*;
5. the indefinite article – *give sb a thick ear; have a good ear for; turn a deaf ear to sb/sth*;
6. the definite article – plural – *set sb/sth by the ears; still wet behind the ears*;
7. cataphoric reference – *have the ear of sb*.

When taking into account phraseological units containing the noun eye, these determiners are used [3], [4]:

1. the quantifier *all* – *be all eyes*;
2. the zero article
 - a) singular – after a preposition – *see eye to eye with sb*;
 - b) plural – after a verb – *cast eyes at sb; make eyes at sb; clap eyes on*;
3. possessive pronouns – *cannot take your eyes off; catch your eye; close your eyes to sth*;
4. the indefinite article – *give sb a black eye; an eye for an eye; have an eye for sth*;
5. the definite article
 - a) singular – *do sb in the eye; the eye of the day; with the naked eye*;
 - b) plural – after a preposition – *in the eyes of*;
6. possessive pronouns + *very* – *before your very eyes; under your very eyes*;
7. cataphoric reference *meet the eye of sb = meet sb's eye*;
8. the possessive pronoun *my* – *my eye!*;
9. possessive pronouns + *own* – *not believe your (own) eyes*.

Analysing phraseological units containing the noun face, the following means of determination are found [3], [4]:

1. the zero article – after a preposition – *face to face*;
2. possessive pronouns – *cast sth in your face; fall flat on your face; fling sth in your face*;
3. the indefinite article – *have a face as long as a fiddle; pull a long face; keep a straight face*;
4. the definite article
 - a) singular – after a preposition – *be black in the face*;

- look sb in the face;*
fly in the face of;
- b) singular – after a verb – *have the face to do sth.*

The below listed forms of determination appear in phraseological units containing the noun *foot* [3], [4]:

1. the cardinal numeral *one* – *have one foot in the grave;*
2. the zero article
 - a) singular – after a preposition – *be on foot;*
set sth on foot;
 - b) singular – after a verb – *set foot on;*
 - c) plural – *get cold feet;*
have feet of clay;
3. possessive pronouns – *be run off your feet;*
carry sb off your feet;
drag your feet;
4. the indefinite article – *shake a foot;*
have a foot in both camps;
not put a foot wrong;
5. the definite article
 - a) singular – *get off on the right/wrong foot;*
catch sth on the wrong foot;
6. the possessive pronoun *my* – *my foot!;*
7. the quantifier *both* – *have both feet on the ground.*

Hand is the most frequent body part noun in phraseological units and naturally it allows the greatest variety of determiners:

1. quantifiers – *many hands make light work;*
on every hand;
on all hands;
2. the zero article
 - a) singular – after a preposition – *at hand;*
get out of hand;
from hand to hand;
 - b) singular – after a verb – *be hand in glove with sb;*
tie sb hand and foot;
go hand in hand;
 - c) plural – *be in good hands;*
change hands;
with clean hands;
 - d) before ordinal numerals – *at first hand;*
at second hand;
3. possessive pronouns – *cross your hand with silver;*
dip your hand in your pocket;
eat out of your hand;
4. the indefinite article
 - a) after a verb – *bear a hand with;*
take a hand with;
play a good hand;
 - b) after a preposition – *with a high hand;*
 - c) *a fresh hand;*
an old hand;
5. the definite article
 - a) singular – *ask for the hand of;*
bite the hand that feeds one;

- get the upper hand;*
- b) plural – *at the hands of;*
6. possessive pronouns + *own* – *for your own hand.*

The noun *head* is preceded by these determiners in phraseological units of the English language [3], [4]:

1. the cardinal numeral *two* – *two heads are better than one;*
2. the zero article
 - a) singular – after a preposition – *from head to foot;*
over head and ears;
 - b) singular – after a verb – *be head and shoulders above sb;*
fall head over heels in love;
be unable to make head or tail of sth;
 - c) plural – *heads or tails;*
heads will roll;
3. possessive pronouns – *bang your head against a brick wall;*
be above your head;
beat your head against a brick wall;
4. the indefinite article – after a verb/preposition
– *bring sth to a head;*
have a head like a sieve;
by a short head;
5. the definite article – singular – *knock sth on the head;*
6. the possessive pronoun *my* – *I will eat my head if;*
7. the possessive pronoun *its* – *stand on its head;*
8. possessive pronouns + *own* – *on/upon your own head;*

Phraseological units containing the noun *heart* offer these combinations of a determiner and the noun [3], [4]:

1. the zero article
 - a) after a preposition – *have sth at heart;*
be in (good) heart;
be out of heart;
 - b) after a verb – *lose heart;*
take heart;
 - c) *heart and soul;*
heart of oak;
2. possessive pronouns – *bare your heart to;*
break your heart;
find it in your heart;
3. the indefinite article – *have a heart of gold;*
have a heart of stone;
4. the definite article
 - a) singular – *from the heart;*
have the heart to do;
5. the quantifier *all* – *be all heart;*
6. possessive pronouns + *own* – *after your own heart;*

4. Conclusion

There are several factors which influence the choice of a determiner in the studied fixed phrases. Semantics and communication goals are the aspects that determine this choice in the first place. Another one is frequency – the more frequently used noun we

take into account, the more petrified phraseological units it offers and the more constructions against the rules we can observe.

Only a limited number of determiners occur in phraseological units which contain names of human body parts. The definite article, the zero article, the indefinite article and possessive pronouns represent the most frequent ones; on the other hand, quantifiers, cardinal, ordinal numerals, assertive determiner *some* and negative determiner *no* are only marginally used; the remaining classes of determiners mentioned in Part 1 are not applied at all.

We analysed 440 phraseological units, only 6 of them are exceptions to the generally excepted rules concerning the usage of determiners, which represents 1.36%. The noun *foot* in *set foot on*; the noun *hand* in *be hand in glove*, *at first hand*, *at second hand*, and the noun *heart* in *be in good heart*, *lose heart* behave against the rules.

Approximately 15 % of the studied phraseologisms allow a certain variation in the usage of a determiner within them; in these

cases, it is possible to apply equally the definite article, the indefinite article/a possessive pronoun; the zero article/the definite article, the indefinite article (a slight variation in semantics may appear):

two equal determiners – *make some/no head against*;

an/the iron hand in a velvet glove;

lay – /your hands on;

put your/the best foot forward;

loose face/loose your face;

make/pull a face/faces;

be up to the/your ears in sth;

have an/your eye on;

three equal determiners – *run an/the/your eye over*.

Two determiners are combined in front of one noun in approximately 2% of the analysed fixed phrases:

the quantifier *all* + the possessive pronoun *my* – *all my eye*;

the quantifier *all* + possessive pronouns – *with all your heart and soul*;

the definite article + *one/other* – *on (the) one hand/on the other hand*.

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Dalibor Mikulas *

INTRODUCTORY REMARKS ON THE STRATIFICATION OF BORROWINGS THROUGH THE WORK OF MARY SERJEANTSON

Abstract: This paper examines the area of borrowings, the definition of borrowing as a process, the broader debate on the conditions of borrowing, reasons for borrowing describing both linguistic and extralinguistic aspects, the stratification of borrowings with its subclasses and consequent terminology. All of these issues are debated on the basis of the work of Mary Serjeantson.

Key words: borrowing, loanword, typology, extralinguistic factor, diachronic perspective

1. Introduction

The English language in general, and its lexis specifically, have been expanding through the process of borrowing. This particular enlargement of English vocabulary, in contrast to the previous periods, has not had such an impact as it used to have in the past, for instance in the Middle English period. However, as defined by David Crystal, "English has been open to a huge number of borrowings and it seems to have far more words in its vocabulary than other languages" [4, p. 42]. That is why it is of importance to deal with the linguistic stratification of borrowings and their definition as well.

2. Borrowing and extralinguistic factors

Interestingly, it was already in the 1930s when Mary Serjeantson stated in the initial part of her book related to the problematic of the foreign element in English that "the English language has throughout its history accepted with comparative equanimity words from other languages with which it has been in contact, and though there have been periods during which speakers and writers of English have made use of foreign words to an exaggerated extent, it is probable that most people will agree that the foreign element in normal English usage has been of value" [9, p. 1]. This introductory statement brings a concerned reader to at least two significant points that fit the area of interest of present-day linguists as well. The first of them is the importance of language contact that has been under a more thorough focus in the recent years under the title contact linguistics [cf. 11], while the second one refers to the value of the foreign element in the history and present-day state of the English language [cf. 3]. With respect to the former point of the language contact, M. Serjeantson specifies, in her own typology, several extralinguistic factors that have been playing a crucial role in the history of the foreign element within the English lan-

guage or a language in general /a more up-to-date theoretical debate on the issues of extralinguistic reality and extralinguistic factors in general can be seen for example in: [6], [10] and [5].

The first extralinguistic phenomenon of the aforementioned typology describes the situation in which two different languages meet under certain circumstances and it is the number or quantity of speakers, one in majority and the other one in minority, which plays a significant role in the context of borrowing. As Serjeantson specifies, "when one nation subdues another which speaks a different language, the conquerors, if their object has been political power rather than settlement, may constitute an authority, or ruling class, which is from the point of view of numbers, much in the minority with the whole body of the conquered people. In case like this, it is usually the native language that survives, though the incoming dialect will very probably transfer to the native vocabulary words which express its own methods of government, and other cultural words" [9, pp. 1-2]. As Serjeantson adds, the epoch of Norman-French in England is a suitable example for this extralinguistic characterology. However, with respect to this specification it must be noted that the number of the Norman-French was, despite the majority English element, growing considerably during the Middle English period [cf. 2].

The second factor of the typology, as put by M. Serjeantson, refers to the opposite situation where "the conquered country or province does not become an independent state under its new rulers, but is controlled by the original government, so that the ruling class is in constant contact with, and continually reinforced by, people speaking their own language, it has usually happened that the dialect of the rulers has won the day, and has spread throughout the community, absorbing some words from the native speakers, chiefly such as concern local products, natural features, etc., but without necessarily undergoing radical changes in itself" [9, p. 2]. However, this example of the typology is illustrated by Ser-

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jeantson in a different context than the English one, i.e. by the relative position of the Romans in Gaul where Latin absorbed a relatively small amount of the native Gaulish dialect words and thus became established.

The third factor of the typology points again to the English-speaking context and historical experience. M. Serjeantson claims that “a different set of circumstances arises when the invasion is for the purpose of settlement or colonization rather than merely for the sake of political power. If the newcomers arrive in such numbers as to form a majority over the native speakers, and in such military or political strength as to acquire complete control over these, or dispossess them, the dialect of the conquerors or colonists will have the upper hand from the start, wherever they establish themselves. They will, however, adopt from the natives whom they displace words which denote native products, etc., and occasionally native customs, which may have been unfamiliar before” [9, pp. 2–3]. Upon the given situation, the arrival of Anglo-Saxons to England and the consequent development of Old English could be seen as a clear example.

The fourth aspect of her diachronic perspective refers to the last centuries of Old English period and particularly to the language contact with the Norsemen or in other words with the Scandinavian element. As it is provided by M. Serjeantson, “sometimes warfare aiming at conquest results in a type of immigration, rather than colonization, as in the case of the Scandinavians in this country, where conflict led finally to more or less peaceful settlement, where the invaders established themselves side by side with the natives without overwhelming them or driving them out, and where the race, customs, and even the language, of the two peoples were sufficiently alike to make intercourse between the two, and the subsequent bilingualism, easy and natural” [9, p. 3]. Here, besides speaking about borrowings, this epoch of the language contact is also of a rather high level of importance in relation to the development of the present-day analytical character of the English language, mainly when analyzing the consequent loss of inflectional endings that were the point of difference between the English and Scandinavian languages at the turn of the Old English and Middle English periods, and thus these inflectional endings were, as some scholars assume, left out to ease the mentioned communication [cf. 2, p.157].

The fifth factor regarding the importance of extralinguistic phenomena in the study of borrowings refers, according to M. Serjeantson, to such contexts as can be seen for instance in American English and the immigrant experience. “If the immigrants come in a large enough body to form a small community of their own within the greater one, they are likely to retain their own speech, for a time at least, even though eventually yielding to the pressure of the language spoken all about them” [9, p. 3]. There are many examples of this type of the communities which came to the U.S. /e.g. Germans, Jews, etc./, preserved their own language, but gradually have been losing it /for a better understanding of this phenomenon illustrated on the basis of the Slovak immigrant experience in the US and consequently American English, see [8]/. In spite of this, it was these communities that influenced the language

of the majority so that the language of the majority finally absorbed some of the foreign elements from the lexis of the aforementioned communities.

Finally, as it can be summarized in accordance with M. Serjeantson’s diachronic concept from the 1930s, there is the sixth extralinguistic factor of a rather significant value for the English language in the area of borrowing, and that is a merchant-adventurer issue, or in simpler terms the phenomenon of trade. “For the English speakers, trade has always been an important factor in the introduction of new words and of new ideas. Even before English had separated from its Germanic stock it was trade almost as much as conquest which brought into it its first words from other languages [...]. In this respect trade and scientific exploration go hand in hand, and can hardly be separated; and the merchant-adventurer holds an important place in the history of the English language” [9, pp. 3–4]. It is useful to add a comment that despite the fact that M. Serjeantson published this typology of hers in the first half of the 20th century, long before WWII, the issue of trade, besides the aforementioned phenomenon of conquest of any extend, bridges the gap between her period and the beginning of the 21st century, i.e. the global period of the Internet Age and Permanent Information Revolution.

3. Stratification of borrowings defined by M. Serjeantson

Given the above mentioned specifications, it may be stated that it was M. Serjeantson [9] who presented a systematic outline of extralinguistic phenomena playing an important role in the linguistic analysis of the problematic of borrowings. However, with respect to the stratification of borrowings, or – as defined in her own words – the loans, the analysis she presented is quite brief, pointing just to general subcategories. Thus we can state that according to the already defined and when paying attention to the given process of borrowing, M. Serjeantson [9] speaks about six, let us say, categories: loans, learned words, repeated loans, indirect borrowings, translation-loans, and loans whose clarification is later extended [cf. 11]. As she characterized, under the already mentioned extralinguistic phenomena, words are borrowed either in actual speech, or secondly, there are situations in which words are borrowed through the written language. A suitable example for this case of lexical borrowing could be seen on the role of Latin in the history of the English language “when English writers and translators took over, from Latin originals or models, Latin words to serve their purpose, sometimes retaining their original inflexions, sometimes using the appropriate English inflexion” [9, p. 4]. M. Serjeantson calls these words “learned words”. They belong to such areas as science and literature, but the area of popular speech, too. As to the above mentioned third type of borrowings presented by her, it is in fact a word, either a popular, learned or technical one, which is borrowed from the same or different source more than once. These, the so-called “repeated loans”, are represented in English in large numbers [9, pp. 4–5] and it may be even added that the given statement also deals with the diachronic point of view, i.e. the historical development of the English language when,

for instance, English came into contact with the Latin language in the Old English period, then in the early period of Middle English it came into an extensive and massive contact with the French language and its varied dialects, and in the period of Renaissance again with Latin, Greek, French and other Romance languages.

The next M. Serjeantson's category of borrowing is the so-called "indirect borrowing", i.e. borrowing through an intervening language. Many words from the east integrated firstly in the early times to Greek, then to Latin and finally into English /e.g., pepper, camel, etc./. These indirect ways of borrowing were even more complex, involving more than three or four languages /e.g., elephant, albatross, apricot, etc./ [9, pp. 5-6].

A regular present-day subcategory of loanwords, the loan-translations, is characterized by M. Serjeantson as "translation-loans, especially common in case of compounds in the older periods of English, when a foreign word expressing a new idea is represented by the nearest equivalent of each of its elements, as when in Old English, for the Latin word *uni-cornus*, the English form *an-horn* /one-horn/, is coined..." [9, p. 10], or for the word *evangelium* the English variant *god-spell* /*gospel*/ was used.

Finally, as it is clear from the discussed source, it may be stated that borrowings at the beginning of their functioning can chiefly

refer to the phenomena connected with the countries they come from, but later on these borrowings can extend their meaning in a wider perspective. Thus they construct another, separate subcategory, or in better words a phase through which they respond to the need of expressing the additional meaning. Truly, even the linguistic means arranged, for a certain time, in J. Algeo's regular column *Among the New Words* point to the true character of this Serjeantson's statement (see the extended sense of, for example, the word *perestroika* [1, pp. 244-245]).

4. Conclusion

The above typology of borrowings and their subcategories introduced by M. Serjeantson was later supplemented in a more exact and certainly a more elaborated manner by a number of distinguished scholars. So, this area needs to be further discussed in a more extended way, most suitably in some of the coming publications. Nevertheless, it is significant to take into consideration the fact that it was M. Serjeantson who, early in the 1930, contributed to the area of foreign elements in the English language with a careful analysis of loanwords.

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MATHEMATICS AND FINANCE

This article presents how mathematical tools can be used in finance. It also shows some interconnections among several parts of mathematics as mathematical analysis, numerical analysis and financial mathematics. Linear interpolation is used to calculate unknown interest rate in various parts of financial mathematics.

Key words: mathematics, finance, interest rate, yield to maturity, linear interpolation.

1. Introduction

Mathematics is science widely used almost in all areas of human life, so it is possible to claim that it is interdisciplinary science. People intuitively expect mathematics in natural and computer sciences as physics, informatics or in various technical sciences as machine engineering, civil engineering or electrical engineering. The majority of disciplines mentioned above are provided at our university. Consequently mathematics is needed to be taught at each faculty in a suitable way so that aspects of each discipline would be satisfied. Many technical subjects are also somehow connected, we can refer, e.g., to [2] where interconnections between physics and electrical engineering are described.

Mathematics is also present in such spheres of interest as economy and finance. In recent times there have arisen many new problems which needed extension of financial mathematics and mathematical modeling of various economic processes. In this article we focus our attention to using mathematics for solving some problems in finance.

The paper is organized as follows. In section 2 there are briefly described some parts of mathematics of finance as general theory of interest rates, ordinary simple annuities and bond pricing. In section 3 the numerical method of linear interpolation is explained and in the next section it is used to compute unknown interest rates. Section 4 also contains several illustrative examples.

2. Mathematics of Finance

Knowledge in the field of mathematics of finance and actuarial science has increased in importance because of the variability and high level of interest rates. Regardless of whether or not your career is in business, understanding how interest is computed on investments and loans is important to you as a consumer.

The study of mathematics of finance usually begins with a simple interest, sometimes used on short-term investments or loans. The simple interest is, by definition, based only on the initial deposit (the principal) which remains fixed during the entire interest period and accumulated value S of principal P at simple interest rate i is calculated according to the formula: $S = P(1 + in)$. Most investments pay a compound interest, i.e., earned interest for each period is added to the principal before the interest is calculated for the next period. The principal grows as the interest is added to it. The account earns an interest on interest in addition to earning interest on the principal. This method is used in long-term investments and a corresponding formula for the accumulated value at compound interest is: $S = P(1 + i)^n$. The third basic method of calculating the interest is by continuous compounding. It is reasonable to assume that the more frequently the interest is compounded, the larger the compound amount becomes. It is clear that as the number of periods per year increases, the compound amount increases, although not very rapidly. The accumulated value under continuous compounding is: $S = Pe^{\delta t}$, where δ is called force of interest.

For a more detailed explanation we can refer, e. g., to [3], where the theory of financial mathematics is described.

2.1. General Theory of Interest Rates

Usually (when using simple, compound or continuous interest) it is supposed that the interest rate is a constant. In reality, when time periods are longer, this is not true. Now, in accordance with [1], let us consider the interest rate to be a function of time, i.e., $i = i(t)$ – which is an effective interest rate at time t : capital of 1 € at time t will increase to $1 + i(t)$ during 1 time period. The interest rate $i(t)$ is an amount of interest of 1 € within time interval $[t_1, t_2]$.

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Let $A(t_1, t_2)$ be the future value of 1 € deposited at time t_1 and due at time t_2 . The value $A(t_1, t_2)$ is called an accumulation factor. For this factor, so called consistence principle is valid, i.e.,

$$A(t_0, t_n) = A(t_0, t_1) \cdot A(t_1, t_2) \cdot \dots \cdot A(t_{n-1}, t_n),$$

$$t_0 \leq t_1 \leq t_2 \leq \dots \leq t_n.$$

Let us denote force of interest for time unit by $\delta(t)$. It is defined by formula

$$\delta(t) = \lim_{h \rightarrow 0^+} \frac{A(t, t+h) - 1}{h},$$

supposing that the limit on the right-hand side exists. Let $t_0 \leq t$, denote $f(t) = A(t_0, t)$. Now, considering that $\delta(t), f(t)$ are continuous functions $t \geq 0$ for and function $f(t)$ is differentiable, we have:

$$\begin{aligned} \delta(t) &= \lim_{h \rightarrow 0^+} \frac{A(t, t+h) - 1}{h} = \lim_{h \rightarrow 0^+} \frac{A(t_0, t) \cdot A(t, t+h) - A(t_0, t)}{h \cdot A(t_0, t)} = \\ &= \frac{1}{A(t_0, t)} \cdot \lim_{h \rightarrow 0^+} \frac{A(t_0, t) \cdot A(t, t+h) - A(t_0, t)}{h} = \frac{1}{f(t)} \lim_{h \rightarrow 0^+} \frac{f(t+h) - f(t)}{h} = \frac{1}{f(t)} f'(t). \end{aligned}$$

Hence, we obtain the differential equation $f'(t) = f(t)\delta(t)$ and its general solution is $f(t) = ce^{\int_{t_0}^t \delta(s)ds}$ where c is some suitable constant.

Using the consistence principle, for $A(t_1, t_2)$ we have:

$$A(t_1, t_2) = \frac{A(t_0, t_2)}{A(t_0, t_1)} = \frac{f(t_2)}{f(t_1)} = e^{\int_{t_1}^{t_2} \delta(s)ds}.$$

If $t_1 = 0, t_2 = t$ then we obtain $A(0, t) = e^{\int_0^t \delta(s)ds}$ and from this $S = Pe^{\int_0^t \delta(s)ds}$. In the case when $\delta(t) = \delta$ for all t we have known formula for continuous compounding.

In this section it was visible how some nontrivial tools of mathematical analysis (differential equations, integrals) can be utilized in mathematics of finance.

2.2. Ordinary Simple Annuity

In this section we derive formulas for calculating accumulated and present values of an ordinary simple annuity, which is a sequence of periodic payments. The accumulated value S of an ordinary simple annuity of n periodic payments of R € each at an interest rate i per period [see Fig. 1.] is the equivalent dated value of the set of these payments due, at the end of the term of the annuity (which is the date of the last payment).

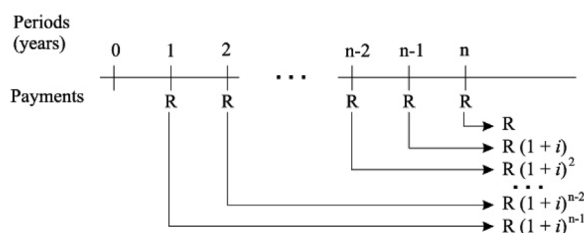


Fig. 1 Ordinary simple annuity

Now we derive the formula for this accumulated value S . The equation of value at the end of the term is: $S = R + R(1+i) + R(1+i)^2 + \dots + R(1+i)^{n-1}$.

This is a geometric sequence of n terms with the first term $a_1 = R$ and ratio $q = 1+i$. Thus, for S we have:

$$\begin{aligned} S &= a_1 \frac{q^n - 1}{q - 1} = R \frac{(1+i)^n - 1}{(1+i) - 1} = \\ &= R \frac{(1+i)^n - 1}{i} = Rs_{\overline{n}|i}. \end{aligned} \quad (AV)$$

Here $s_{\overline{n}|i}$, read "s angle n at i ," is called the accumulated value of 1 € per period, or an accumulation factor for n payments. The factor $s_{\overline{n}|i}$ can be computed directly with a calculator, or found in Tables, listing these factors for certain values of i and n .

Multiplying both sides of equation (AV) by $(1+i)^{-n}$, we obtain a formula for the present value of ordinary annuity A :

$$A = R \frac{1 - (1+i)^{-n}}{i} = Ra_{\overline{n}|i}, \quad (PV)$$

where $a_{\overline{n}|i}$ is called a discount factor for n payments and represents the present value of an ordinary simple annuity of 1 € per period for n periods, with an interest rate of i per period.

The most efficient way to solve an annuity problem is to make a time diagram, determine the type of annuity, and then apply the proper formula.

In this part it is seen as the geometric sequence theory can be used in financial mathematics.

2.3. Bonds - introduction

Financial newspapers list thousands of bonds issued by corporations, municipalities, and the government. In determining which bonds are appropriate for their needs, investors should consider a number of factors, including risk, expected rate of return, and the feasibility of purchasing a short-term or a long-term bond. Tax implications should also be considered.

A bond is a written contract that requires the issuer (borrower) to pay the investor (lender) interest income. Most bonds make fixed coupon payments at a coupon rate r per interest period every year until the bond matures. Bond coupons are like annuity payments. At maturity, the bond issuer must also repay the face value of the bond F . The market price of a bond equals its present value P . Hence the investor who wishes to realize a rate of return i (until the bond is redeemed or matures) should pay a price equal to the discounted value of the n coupons $C = Fr$ plus the discounted value of the face value:

$$P = \frac{C}{(1+i)} + \frac{C}{(1+i)^2} + \dots + \frac{C+F}{(1+i)^n} =$$

$$= Fra_{n|i} + \frac{F}{(1+i)^n}, \quad (MP)$$

which is equivalent to $P = F + F(r-i)a_{n|i}$ known as an alternate purchase price formula.

Since finding the solution for the yield rate per interest period i (often called the yield to maturity) of previous equations is not trivial, the following approximations are used:

1. Hawawini and Vora (1982): $i \approx \frac{C + (F - P)/n}{0.6P + 0.4F}$.
2. Bond Commercial method (Uhlir and Steiner (1994)):

$$i \approx \frac{C + (F - P)/n}{P}.$$

3. Bond Salesman's method: $i \approx \frac{C + (F - P)/n}{(F + P)/2}$.

For more accurately results we can use the method of linear interpolation, which is introduced in the next section.

3. Linear Interpolation

Linear interpolation is the method of functions approximation when linear functions are used to approximate some functions or various measuring data. Using this method it is also possible to compute arbitrary value x lying in the interval between two known numeric data x_1 and x_2 when there are also known values y_1 , y_2 and y as it can be seen in Fig. 2.

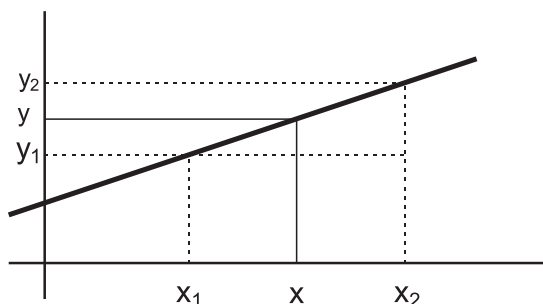


Fig. 2 Sketch for deriving the formula

The easiest way to find a formula for linear interpolation is the triangle similarity theory. We have:

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{y - y_1}{x - x_1}.$$

From this equation we obtain the following formula for unknown x :

$$x = x_1 + (x_2 - x_1) \frac{y - y_1}{y_2 - y_1}, \quad (LI)$$

which will be used later for calculating the unknown interest rate and unknown yield to maturity.

4. Using Linear Interpolation in Mathematics of Finance

In this section it is showed how linear interpolation can be used in financial mathematics to compute unknown interest rate concerning ordinary annuities and bonds. Some illustrative examples are given, too.

4.1. Ordinary Simple Annuity

Using formulae (AV) or (PV) it is possible to compute the other unknown parameters, but it can be seen that the calculating of the unknown interest rate i is not so elementary. Hence when R , n and either S or A are given, the unknown rate i , may be determined approximately by linear interpolation. For most practical purposes, linear interpolation gives sufficient accuracy.

For fixed n , $s_{n|i}$ increases when i increases, whereas $a_{n|i}$ decreases. In general, the closer the bounds on the interest rate i , the better the approximation of i furnished by linear interpolation. We adopt the practice of interpolating between two nominal rates i_1 and i_2 that are 1% apart and using factors $s_{n|i}$ and $a_{n|i}$ rounded off to 4 decimal places. For the linear interpolation we use formula (LI) , where $y_1 = s_{n|i_1}$, $y_2 = s_{n|i_2}$ and $y = s_{n|i}$ or, respectively $y_1 = a_{n|i_1}$, $y_2 = a_{n|i_2}$, and $y = a_{n|i}$.

To obtain a starting value i_s to solve an equation $s_{n|i} = k$ for unknown i by linear interpolation, we may use the formula from

$$[4]: i_s = \frac{(k/n)^2 - 1}{k} \text{ and to obtain a starting value to solve an}$$

equation $a_{n|i} = k$ by linear interpolation, we may use the formula

$$\text{from [4]: } i_s = \frac{1 - (k/n)^2}{k}.$$

Now we are in position to give some simple illustrative examples:

Example 1.

Find the interest rate i at which annual deposits 250 € will accumulate to 5 000 € in 12 years.

We have $R = 250$, $S = 5000$, $n = 12$, $i = ?$ We use the formula (AV) , so in our case we have: $250s_{12|i} = 5000$, that means $s_{12|i} = 20 = k$. To determine the rate i , we find two factors $s_{12|i_1}$ and $s_{12|i_2}$, one greater than 20 and one less than 20, and corresponding values i_1 and i_2 that differ by 1%. These values provide upper and lower bounds on the unknown rate i , which is then approximated by linear interpolation. A starting value is:

$$i_s = \frac{(k/n)^2 - 1}{k} = \frac{(20/12)^2 - 1}{20} = 0.0889 = 8.89\%, \text{ so}$$

$i_1 = 8\%$ and $i_2 = 9\%$ and corresponding factors are: $s_{12|0.08} = 18.9771$ and $s_{12|0.09} = 20.1407$. Substituting all these values to (LI) for unknown interest rate i we have:

$$\begin{aligned} i &= i_1 + (i_2 - i_1) \frac{s_{12|i} - s_{12|i_1}}{s_{12|i_2} - s_{12|i_1}} = \\ &= 0.08 + (0.09 - 0.08) \frac{20 - 18.9771}{20.1407 - 18.9771} = \\ &= 0.0888 = 8.88\%. \end{aligned}$$

We may check the accuracy of our answer by calculating the accumulated value of the deposits at $i = 0.0888$: $S = 250s_{12|0.0888} = 4999.24$. Hence the unknown interest rate is 8.88%.

Example 2.

You are offered a loan of 15 000 € and agree to pay 1500 € annually for 15 years. What annual rate of interest does this loan charge?

We have $R = 1500$, $A = 15000$, $n = 15$, $i = ?$ The way of solution will be similar to the previous example, but we use the formula (PV). We obtain $1500a_{15|i} = 15000 \Rightarrow a_{15|i} = 10 = k$. The starting value is determined as: $i_s = \frac{1 - (k/n)^2}{k} = \frac{1 - (10/15)^2}{10} =$

$0.0556 = 5.56\%$, interest rate values that differ by 1% are: $i_1 = 5\%$ and $i_2 = 6\%$ and corresponding two factors are: $a_{15|0.05} = 10.3797$ and $a_{15|0.06} = 9.7122$. Now using linear interpolation formula (LI) for the unknown rate of interest we obtain:

$$\begin{aligned} i &= i_1 + (i_2 - i_1) \frac{a_{15|i} - a_{15|i_1}}{a_{15|i_2} - a_{15|i_1}} = \\ &= 0.05 + (0.06 - 0.05) \frac{10 - 10.3797}{9.7122 - 10.3797} = \\ &= 0.05569 = 5.57\%. \end{aligned}$$

4.2. Bonds' Yield to Maturity

In the section 2.3. we introduced three approximative methods for computation of yield to maturity of bonds. If a more accurate answer is desired, these methods should be followed by the method of linear interpolation. This method requires determining market prices of a bond for two interest rates, such that one price is smaller and the other is greater than the given quoted price. To do this we use the formula (MP). Linear interpolation, i.e., formula (LI) is then used to find the unknown i . If convenient, the interpolation can be on a purchase price rather than a market price. Methods introduced in section 2.3. can be used to determine a starting point for the linear interpolation.

The following example illustrates the calculating of yield to maturity i .

Example 3.

A company issued bond with maturity time of 14 years, with the face value 2 000 € with coupon rate 9.5%, compounded semi-annually. The market price of the bond is 1 930 €. Find the yield to maturity of this bond.

We have: $F = 2000$ €, $P = 1930$ €, $r = 0.095/2$, $C = Fr = 95$ €, $n = 14 \cdot 2 = 28$, $i = ?$

The starting value of semiannual interest rate is will be found

using, e.g., the bond Salesman's method: $i_s = \frac{C + (F - P)/n}{(F + P)/2} =$

$$= \frac{95 + (2000 - 1930)/28}{(2000 + 1930)/2} = 0.0496, \text{ so annual effective interest rate (yield to maturity) compounded semi-annually is: } i_s^{(2)} =$$

$= 2 \cdot 0.0496 = 0.0992 = 9.92\%$. Now we determine two values i_1 , i_2 : $i_1 = \frac{9}{2}\% = 0.045$, $i_2 = \frac{10}{2}\% = 0.050$ and corresponding

market prices one smaller and the other greater than the given market price 1930 €:

$$\begin{aligned} P(i_1) &= Fra_{n|i_1} + \frac{F}{(1 + i_1)^n} = 95 \frac{1 - (1 + 0.045)^{-28}}{0.045} + \\ &+ \frac{2000}{(1 + 0.045)^{28}} = 2078.71\text{€}, \end{aligned}$$

$$\begin{aligned} P(i_2) &= 95 \frac{1 - (1 + 0.050)^{-28}}{0.050} + \frac{2000}{(1 + 0.050)^{28}} = \\ &= 1925.51\text{€}. \end{aligned}$$

Now we are in the position to use the linear interpolation formula (LI) reformulated to case in question:

$$\begin{aligned} i &= i_1 + (i_2 - i_1) \frac{P - P(i_1)}{P(i_2) - P(i_1)} = 0.045 + \\ &+ (0.050 - 0.045) \frac{1930 - 2078.71}{1925.51 - 2078.71} = 0.04985. \end{aligned}$$

It is visible that unknown annual yield to maturity is $i^{(2)} = 2 \cdot 0.04985 = 0.0997 = 9.97\%$.

5. Conclusion

In this article we introduced some parts of mathematics of finance where calculating of the unknown interest rate is needed and this is non-trivial. In such cases the numerical method of linear interpolation can be used. In this paper also some interdisciplinary interconnections among mathematical analysis, numerical mathematics and financial mathematics can be seen. Hence regardless of some opinions, the world of mathematics and finance is close-knit.

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Peter Hockicko *

NONTRADITIONAL APPROACH TO STUDYING SCIENCE AND TECHNOLOGY

The present paper informs about nontraditional teaching activities which can help teachers and students to reach better results in the studying process. Information and communication technologies (ICT) in physics education can help to increase the effectivity of the teaching process. For students, physical analysis using computer programs is more demonstrative, learning physical equations is quicker, understanding of the physical laws is easier. It is necessary to catch them young. Because of this reason the Children's University of Zilina (CUZ) has been realized in the summer time for children attending elementary school. The questionnaires for children show that it is highly necessary to increase the number of presented experiments, to use multimedia in a larger extent, to develop their imagination and creativity, sense for team work. The interest in nature and technology subjects can be increased by developing the student's imagination and thinking.

"I hear and I forget. I see and I remember. I do and I understand"

Confucius quotes

(China's most famous teacher, philosopher, and political theorist, 551-479 BC)

1. Introduction

Educating people at the present time is rather conceived as giving students help in building intellectual tools and learning strategies that are necessary in acquiring the knowledge that allows people to think productively about history, science and technology, social phenomena, mathematics, and arts [1]. Since the end of the last century society and education have changed. These changes are caused by the fact that the main goal of learning and teaching in schools was to acquire "learning to learn" skills rather than literacy skills in reading, writing, and calculating. The present situation in the society forces students to have the ability to locate and use information rather than memorize it [2]. The meaning of "knowing" has changed from being able to remember and repeat information to being able to find and use it [3]. Research done in this area has shown that when technology is used in teaching, students are more encouraged to solve problems and new ways in exploring information are discovered [2].

Physics and technology are often considered to be difficult subjects. The main reason is that it is not easy to explain empirical laws and dynamic phenomena in textbooks. Multimedia technologies have shown their potential in the teaching of scientific subjects. New techniques attract student's attention, enabling an easier and rapid process of learning. Students like to use and to work with computers and the modern information and communication technologies (ICT). If we connect the work on computers with studying physics, this form of education will become very attractive for

students and we can anticipate that their knowledge in physics will be better [4]. Some university educators try to change the learning process by setting up supplementary courses of physics and using new modern educational methods such as computer presentations, simulations, animations, experiments, and qualitative tasks [5]. Some new courses developed within the ComLab (Computerized Laboratory in Science and Technology Teaching) bring a set of computerized laboratory experiments [6]. A lot of students agree that they enjoyed the studio courses (the Couple Physics Studio, etc.) as compared to the traditional lecture/lab format. Students in these courses are performing as well as or better than students in the traditional courses in spite of the 33.3% reduction in class contact time [7]. Students will feel more involved and responsible for their own learning experience if we bring more drama into the classroom by re-enacting science, which should help them visualize and remember the lesson [8]. It is very important to use the multimedia tools in other subjects including basic education to make science and technology more appealing and to address the scientific apathy crisis of young people [9]. We can anticipate that the multimedia aid will help to increase the efficiency of the technical education in elementary school [10]. Teachers and scientists from University of Zilina have tried to motivate young people to future study of science or technology through realizing the Children's University of Zilina (CUZ) [11-13].

Advanced methodology and approaches can change the study of nature and technology and it can be a challenge for the teachers and their students.

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2. Competencies and their relation to learning outcomes

The textbook may be a powerful aid to teaching and learning. But since learning is related to the goals of education as a whole, textbooks are limited to those which can be expressed in written print. Alternatives to the textbook can be various modules prepared by teachers. Teaching modules can be based on competencies which can focus on the educational capabilities (knowledge, skills, values, etc.) to be developed. The building of a competence means to effectively apply transferred knowledge and skills. The competencies are the capabilities to be developed. They are best regarded as transference abilities involving higher order, analytical, modeling or evaluative skills.

Generally speaking, a school curriculum should achieve three broad educational aims:

- *Acquisition of knowledge, skills, abilities or capacities.*
- *Development of competencies, i.e. the ability to apply the knowledge and skills imparted by education to real-life situations.*
- *Development of key competencies, i.e. those that are essential in order to participate effectively in the activities within the society [14]*

Teaching of the science subjects takes place through the development of lifeskills and the gaining of competencies associated with the interrelationship between knowledge, skills, and values [14].

One of the ways how the development of the key competencies (development of manual skills and intellectual capabilities) can be improved is applying the ICT in the teaching and studying processes.

3. Taxonomy of Educational Objectives

In 1956, Benjamin Bloom developed a system of categories of learning behaviour to assist in the design and assessment of educational learning. Skills in the cognitive domain revolve around knowledge, comprehension, and critical thinking of a particular topic. Traditional education tends to emphasize the skills in this domain, particularly the lower-order objectives. Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation. There are six levels in the taxonomy, moving through the lowest order processes to the highest:

- *Knowledge* – exhibiting memory of previously-learned materials by recalling facts, terms, basic concepts, and answers,
- *Comprehension* – demonstrative understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas,
- *Application* – using new knowledge, solve problems arising in new situations by applying acquired knowledge, facts, techniques, and rules in a different way,
- *Analysis* – examining and breaking information into parts by identifying motives or causes, making inferences, and finding evidence to support generalizations,

- *Synthesis* – compiling information together in a different way by combining elements in a new pattern or proposing alternative solutions,
- *Evaluation* – presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria [15].

Bloom's Taxonomy is a reference model for all involved in teaching, learning, training, coaching – in the design, delivery and evaluation of these development methods. The training for technicians may cover knowledge, comprehension, and application, but not concerning oneself with analysis, synthesis, and evaluation, whereas full professional training may be expected to include this and synthesis and evaluation as well.

4. Interactive tools in teaching and studying process

Computer modeling that engages students directly in the development of physical models is becoming an increasingly important part of physics education [16]. It was found in previous study [4] that students like to work with computers and that 82 % of them would prefer practical exercises in the subject Physics in multimedia laboratory using computers instead of using classical forms of studying in classroom. Studying using computers (e-learning) compels the students to work in an independent and creative way.

Video analysis of real-world videos gives students a relatively simple way to find basic principles and laws of nature. Students can study real objects which have been captured on digital video. They can record what is important for them, from basketball shots on the playground to jumping, and other favorite activities. It can be used in physics, math, science, and other fields to help to teach concepts, to improve students' understanding of graphs, and to get students involved in their education in a funny way.

Every motion in one or two dimensions can be analyzed using some useful programs such as VideoPoint, Coach, VirtualDub and E-ruler [17], Tracker. One can plot position, velocity, acceleration, and much more as a function of time. As the authors of the VideoPoint say, a careful movie taking and analysis can easily provide results within 5% of the theoretical values. The ease of using these programs can encourage students to do experiments and to analyze their own videos. These programs develop students' creativity and some students can find new ideas that they can use in analyzing real situations. R. Beichner shows [18] that increased usage of a Video Analysis tool improves students' understanding of kinematics graphs.

The program Tracker – free Java video analysis and modeling tool from Open Source Physics [19] – has been used to analyze a splashed fountain – concretely dropping water to determine position, velocity and finally acceleration (Fig. 1). In a typical video analysis, students capture and open a digital video file, calibrate the scale, and define appropriate coordinate axes. From the number of frames per second the time is deduced, while the position information can be measured in two dimensions from the video image

after calibration. The motion can be divided into two parts: the horizontal component and the vertical component. These two components can be calculated independently of each other and then the results can be combined to describe the total motion. The only forces acting on the splashed water are the forces of gravity and the air resistance. We can assume that the effect of air resistance is negligible. The vertical position and the velocity are plotted and fitted to see the correlation between the real data and the kinematic equations (Figs. 2-3).

Figure 3 shows that the velocity of the splashed water in the vertical direction changes nearly at the same rate throughout the motion. Because of this the average acceleration in the vertical direction over any time interval equals the instantaneous acceleration at any instant. Therefore, the analyzed motion of a ray of water in the vertical direction can be mathematically described by equations valid for motion at a constant acceleration a_y

$$y = 1/2a_y t^2 + v_{0y}t + y_0, \quad (1)$$

$$v_y = a_y t + v_{0y}, \quad (2)$$

where v_{0y} and y_0 are the velocity and position at the initial time $t = 0$; y and v_y position and velocity at some later time t .

The position x in the horizontal direction at time t can be described by the equation

$$x = v_{0x}t + x_0, \quad (3)$$

where v_{0x} is velocity and x_0 position in the horizontal direction at the initial time $t = 0$. By doing a mathematical fit (Fig. 2) students can find that the trajectory of ray of water is always parabola which can be described with equation

$$y = at^2 + bt + c. \quad (4)$$

Comparing equations (1) and (4) gives $a = 1/2a_y$, $b = v_{0y}$, and $c = y_0$. Then from this fit students have found that $a_y = -9.83 \text{ m.s}^{-2}$ which is in agreement with value of free-fall acceleration. Analogically the mathematical fit to the velocity of ray of water in vertical direction (Fig. 3) is always a straight line which can be described by equation $y = at + b$. Comparing this equation with equation (2) students get $a = a_y$, $b = v_{0y}$. This gives $a_y = -9.7 \text{ m.s}^{-2}$ which is in agreement with value of free-fall acceleration, too. The second parameter $b = 7.24 \text{ m.s}^{-1}$ (7.14 m.s^{-1}) corresponds to the initial velocity in the vertical direction.

To do a physical analysis we can think about "Projectile motion" which is a type of two-dimensional motion in the xy plane with constant acceleration whose components are $a_x = 0$ and $a_y = -g$. Usually it is useful to think of this motion as the superposition of two one-dimensional motions: (1) motion in the horizontal direction at constant velocity and (2) free-fall motion in the vertical direction subject to a constant downward acceleration of magnitude g .

Using the functions Slope and Area one can demonstrate mathematical connection with the derivative and the integral of func-

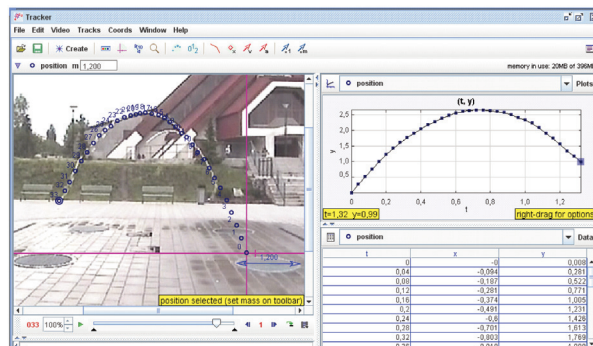


Fig. 1 Analyzing the motion of water moving from a fountain (Zilina, housing estate Vlnce)

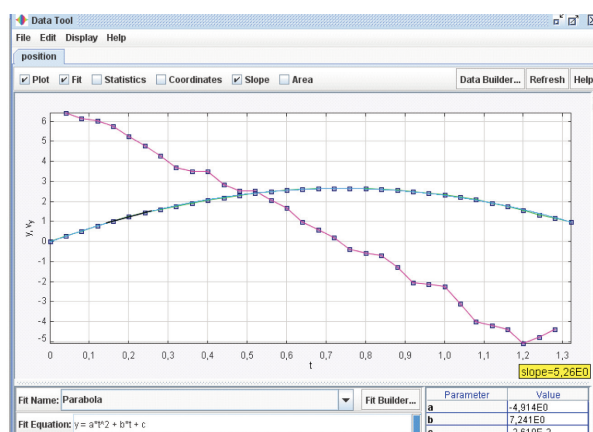


Fig. 2 Time dependences of y -position (blue) and y -velocity (pink). From the analyzed data ($y(t)$) that were obtained for the vertical direction students could find the parameter a which is connected with the free-fall acceleration ($g = 2*a$) and parameter b which is connected with initial velocity in vertical direction ($v_{y0} = b$)

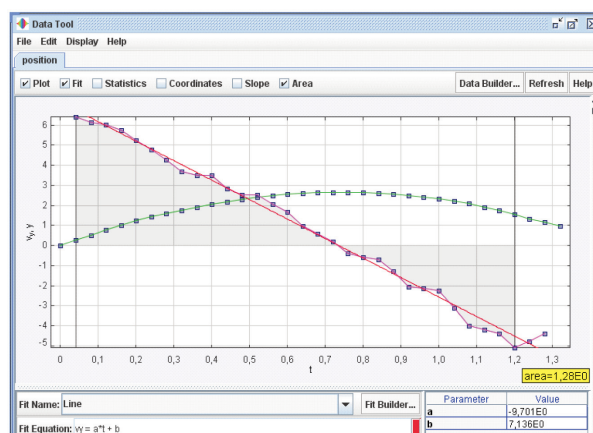


Fig. 3 Time dependences of y -position (green) and y -velocity (pink). From the fit to the equation for $v_y(t)$ students found the parameter a which is connected with the free-fall acceleration ($g = a$) and parameter b which is connected with initial velocity in vertical direction ($v_{y0} = b$)

tions (derivation of the function $y(t)$ at the $t = 0.2$ s shows the value 5.26 which is the same as velocity at this time (Fig. 2); integration of the function $v_y(t)$ in the range $t = 0.05 - 1.2$ s shows the value 1.28 which is very close to the y -position at the time 1.2 s (Fig. 3)).

Using this program, the teacher can easily demonstrate the relationships between mathematical functions and the real world. Many of the motions of interest can be described by analytic functions.

These analyses of the real-world videos enable us to realize student's activities on the levels: analysis, synthesis or evaluation of the Bloom's Taxonomy of Educational Objectives.

5. Motivation of young people

Any physics teacher would like to teach the students to use physics, logical and technical thinking that they need in practical life. In order for the students to have positive relation to studying physics and technology in future, the basic idea is to inspire and motivate pupils and young people in such a way that they become interested in science. The Children's Universities help us to achieve this goal.

The primary goal of the Children's Universities (CU's) is to undo the reservations the young people have concerning the scientific and academic issues at large. The long-term goal is to awaken interest and enthusiasm of children and young adults, as well. The objectives of the Children's Universities can be summarized as follows:

- *Promotion of the interest in science*
- *Increased face to face contact of children and scientists, to improve the contact with the young people, to open up the university campus to the public*
- *Increased knowledge about science and scientific careers*
- *Combating stereotypes and using new technologies*

In order to integrate the existing CU's, it was important to establish network of the Children's Universities - EUCU.NET - European Children's Universities Network. At present time, 122 CU's from 21 countries, more than 250 registered individuals have initiated such events.

What is the progressive feature that the Children's Universities breed?

- *Encouraging children to be curious and to think critically - it is the mainsprings of research and science*
- *Working with young people in such a way as to help universities to be more responsive*
- *Making encounters between children and "the university" (as a community of academic staff and students) possible*
- *Enthralling them with diverse scientific fields (from humanities, to social sciences and natural sciences) and with diverse scientific methods unbiased by commercial interest*

- *Giving young people an understanding of their future educational choices and options*
- *Contributing to the enhancement of universities concerning their organizational, didactical, and research development [20]*

The Children's University of Zilina (CUZ) has evolved in order to popularize the results of science and technology through lectures and practical exercises given to young people, the schematic discovery of technical subjects, and the stimulation of independent creative thinking. Teachers and scientists want to increase the educational level of the nation with emphasis especially on young generation to show research and development importance for the future public improvement. We want to bring technical science to the attention of the school age children, to eliminate their respect of such subjects as mathematics and physics, and to near them the meaning of research and the application of its results in everyday life. We would like to show young people the way they can learn to think and develop their knowledge, not only to absorb presented knowledge.

The Children's University of Zilina was established in 2005 and it has been taking place at regular intervals: once a year, during one week (5 workdays from 8 a.m. till 4 p.m.) in the summer time. Children are divided into teams of up to 20 children per each team. Depending on each single activity, teachers, scientists, and researchers prepare for 8-12 years old children lectures, exercises, demonstrations, and excursions. Our lecturers are the academic staff of university.

There are two "degrees" that can be obtained at the CUZ: the first degree can be granted in the study program "Little Bachelor" to children who completed the 2nd or 3rd year of the elementary school. They discover basic nature laws. After being granted this degree, children can continue in the following year to obtain the degree "Little Engineer". These groups try to find the way how to apply the laws of nature in technology. Children attend a series of lectures in the morning and object-lessons in the university laboratories in the afternoon. Some of them are: "How do the things move?", "How do the waves move?", "How can I hear?", "How do we see things?", "How to navigate a train", "How does the mobile telephone find Michael?", "How can the temperature be made visible?", "How do the semiconductors light?", "How is film made?", "The fascinating world of chemistry", "About universe and planets", "Science as a game", and so on.

When we asked children in a survey what they liked most about the Children's University, nearly half of them (46%) chose the laboratory exercises, 22 % would like more lectures, 18 % wanted to work on PC and 14 % wished more outdoor games. 85% of children prefer the classes in which they can put in practice their own ideas and work actively and creatively, only 15% would like to work in classes in which they obey commands of the teachers. 57% of children who graduated in the study program "Little Bachelor" and 53% of children who graduated in the study program "Little Engineer" said that they wanted to work as a scientist [12] (the total number of the respondents was 600, years of realization 2005-2009). What is the real situation in our country? Only 6% of the

university students studied nature, 29% technology and 50% of the university students studied social sciences in the academic year 2005/2006 in Slovakia [21]. The comparison of the teaching activities at the primary school and at the CUZ suggests that if we change the technique (the methods) of teaching, the children who “like it sometimes” (at elementary school) will “always like it” (at the Children’s University) [13].

Children’s Universities can develop the technical skills and the abilities to learn of the young people and they can improve their knowledge and skills that they will use in their future life.



Fig.4 Experimental activity at the Children’s University of Zilina

Conclusion

New multimedia techniques and technologies attract students’ attention enabling easier and rapid process of learning. Interactive programs and multimedia tools with simulation and movies develop students’ creativity and their creative thinking; encourage them to experiment and to analyze their own movies and videos. Using computer software, teachers can easily demonstrate the relationships between mathematical functions and the real world described by physics. Utilizing useful computer programs in physical analysis

of real processes is one of the ways how the key competencies of students can be strengthened. Computing technologies will help in the transformation of a traditional school to a creative one. By changing the activities of the teachers during the lecture, e.g. using interesting experiments and including the activity of the students, one can build in young people interest in studying physics and technology. Full training, teaching, and learning may be expected to include analysis, synthesis or evaluation of Bloom’s Taxonomy of Educational Objectives.

It is very important to use these tools also in other subjects including basic education to make science and technology more appealing and to address the scientific apathy of young people. One of the ways where we can start with this is realizing Children’s Universities as a form of motivation of young people for the future study of science and technology. Young people expect wide usage of information and communication technologies in education. They eagerly want to work in an active way and to carry out their own ideas. Undoubtedly children of age under 10 have a genuine but hidden interest in natural and technical sciences; they want to become scientist and explorers. However, after several years of education at the elementary level the situation is completely changed. Advanced approaches and methodology aimed at holiday activities at elementary school level have been proved as suitable. It was a challenging opportunity to develop and broaden educational and didactical skills of the university staff cooperated in the Children’s University of Zilina.

We try to put a great effort to “make school a game” (“schola ludus”) and to involve in the educational process the maximum possible number of senses “... let everything be put forth to all senses. That means things viewable to the sight, hearable to the ear, smelling to the nose, tasteable to the taste, and touchable to the touch; if one can perceive something through several senses at once, let it be put forth to several senses.” as a distinguished pedagogue J. A. Komenský said.

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Miroslav Nemec *

MODERN METHODS APPLIED IN TEACHING PHYSICS

This paper deals with modernization of teaching acoustics. We prepared the study material with qualitative exercises. In the text we pay attention to physical and ecological aspects of sound and noise. Further we analyze sound as an example of mechanical waves. The main part of the work is creation of video experiments in the field of acoustics as well as experiments supported by the computer software that would enable analysis of sounds and sound filters. We created ten experiments and further developed them into methodological and study material.

Keywords: physical experiments, video experiments with sound.

1. Introduction

Physics and mathematics provide the foundation for further technical and technological subjects. That is why sufficient time should be invested in order to make students understand the rules and relations in physics. However, many experts disagree with the above and little time is provided for physics. Reduction of time assigned for physics education has been ongoing. Another problem is a broad variation in subject knowledge of students coming from different types of secondary schools. At some of them the level of the knowledge is still very low and has been decreasing. Most students come from secondary schools where physics is considered an optional subject. In a better case physics is taught at schools for a period of two years. Therefore, there is no real foundation to be built on. Only a small number of students come from secondary grammar schools where a sufficient base is provided with respect to physics [3].

Unfortunately, universities these days increasingly accept students for studying at their institutions in accordance with requests of society and not students' knowledge level. As a result the level of university education has been increasing. It is in particular visible at the technical universities as this type of education is neither very popular nor lucrative for contemporary students. [7].

2. Acoustics

At our university acoustic is studied as a part of physics where the latter is a core subject of every field of studies. Preceded by the topics on "oscillation and waves", this part of physics confronts students with the most difficult math functions. Therefore, it is very important to familiarize them with the topic in question in a more approachable manner.

Within their further professional specialization, students in secondary education can opt for subjects based on acoustics, such as physics of musical instruments, experimental non-destructive methods, acoustics, selected chapters on building and architectural acoustics.

Despite the limited time provided for teaching, it is our attempt to explain the students in the most approachable manner the basics of physical and acoustic knowledge and its practical application. Therefore, our aim is to create a complex study material related to this part of physics which could be used in higher levels of secondary grammar schools. It consists of learning material, problem solving assignments and physical experiments.

3. Qualitative assignments

Qualitative assignments in physics support both the deepening as well as strengthening of students' understanding of new knowledge. It allows to verify students' knowledge and their ability to apply it. Further, the assignments increase students' interest in subject and support an active understanding and application of learnt material during the teaching process. Qualitative assignments have a significant impact on the development of physical thinking. The assignments solved by the simple physical reflection are the ones most commonly used at schools. These assignments begin with the question "Why?" Questions of this type lead to looking for consequential connections and mutual relations between individual physical actions.

While solving qualitative assignments students are forced to get a deeper insight into the problematic situation. In many cases they realize that they do not understand it as well as they initially thought. A great advantage of qualitative assignments is a practical

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application of theoretical knowledge. At the same time the accuracy of learnt theories is verified. Solving qualitative assignments allows students to analyze situations; it helps to develop their logical thinking, contrivance and creativity. By applying physics they learn to explain everyday natural occurrences as well as those from technical environment. This also prepares them for a practical life. In order to preserve a learning function of the qualitative assignment, teacher is responsible for specifying its aims. In this case the assignment carries out a didactical function and follows didactical aims of the class. Again, when working on the assignments it is important to follow a certain algorithm of individual tasks.

3. Experiments

One of the most important parts of physics education is its experimental element. Experiments visually demonstrate events and occurrences described by physical laws, principles as well as mathematical relations. Their importance has been gradually increasing. At the present we deal with experiments from the field of acoustics. This is in form of sound recordings followed by the analysis which is used to explain basic expressions from acoustics as well as by video experiments. Application of these experiments can prepare students for possible problems, they may experience in life [5].

It is possible to use such experiment in various stages of a lesson – presentation of a new topic, repetition, etc. It is only up to the teacher when he/she will use it. Before the integration of video experiments into physics teaching students must have made experience with conducting of classical experiments. If not computer might have become dominant focus of student's experimental activity and physics substance of the experiment would not be so important for him [6].

Multimedia technologies have shown their potential in the teaching of scientific subjects. New techniques attract students' attention, enabling an easier and rapid process of learning. Physics and technology are often considered to be difficult subjects. Interactive multimedia tools with computer presentations, simulations, animations and movies are particularly effective in physics teaching. It is very important to use these tools in other subjects, including basic education, to make science and technology more appealing and to address the scientific apathy crisis of young people [4].

5. Experiments Requiring Frequential Analysis

The frequential analysis of sounds is a suitable method for motivation and development of manual skills and intellectual capabilities of students from a very young schooling age. By gradual acquisition of knowledge from physics (or acoustics) and development of mathematical functions this method can be used in higher education courses.

6. Videoexperiments

Some experiments are carried out as video experiments. It is possible to project these experiments at schools where it would not be possible to perform them practically. By means of video experiments students obtain better comprehension as well as get an idea of application of physical principles and laws.

The experiments deal with the measurement of sound velocity in a metal rod using Kund's tube, measurement of sound velocity in the air using an open resonator – U tube, examination of sound pressure level in relation to distance by a sound level meter, Doppler effect, examination of the tone frequency in relation to string tension, creation of beats, creation of Chladni patterns which can be used as a nondestructive method of material properties measurement.

For each experiment students' and teacher's guide are prepared and their structure is designed so that it follows mentioned stages of conducting the experiment. A problem solving task for students is given at the beginning of each guide. Students have to find the solution by conducting the experiments [6].

Experiment is presented here by a short version of student's guide.

1 Chladni patterns

Chladni patterns are named after Ernest Chladni, who published these patterns in 1787 in writing "Discoveries in Sound Theory", in which the patterns were described as well as the way how they can be made. People were with Chladni patterns so fascinated, that for Chladni it was possible to earn enough money through his performances as a teacher and demonstrator. Even Napoleon said: "This man has propagated tones."

What practical significance do Chladni patterns have?
How will the grains behave in antinodes and nodes?

A little bit of theory at the beginning

Chladni patterns are a classic undergraduate demonstration. You can visualize the nodal lines of a vibrating elastic plate by sprinkling sand on it: the sand is thrown off the moving regions and piles up at the nodes. Normally, the plate is set to vibrate by bowing it like a violin. It helps to put your fingers on the edge to select the mode you want, much like fingering the strings of a violin. This takes some practice.

Indication of modes (ways of vibration) on plates with too small thickness related to total proportions. Measurement equipment contains tone generator as a source of harmonic signal and amplifier which amplifies signal coming to loudspeaker. Frequency in generator is changed continuously till the point when on the plate powdered by e.g. tea doesn't occur demanded shape of mode. Čulík and Danihelová describes Chladni patterns in more detail [1, 2].

You can make a nice modernized version of this demonstration using an electromagnetic shaker (essentially a powerful speaker).

What do you need?

tone generator, loudspeaker, resonance plates, sawdust particle

The schema of the experiment

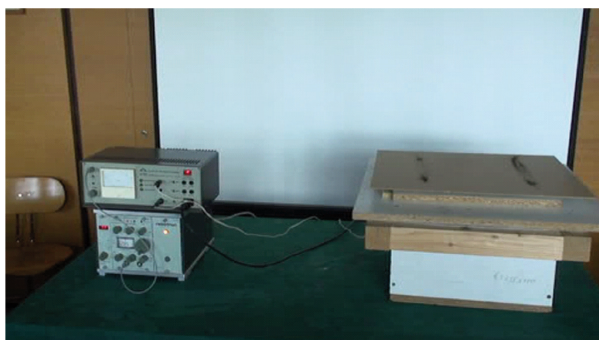


Fig. 1 Chladni's patterns

How to proceed

1. Prepare the equipment according the schema. You can use different thin metal, wooden or plastic plates.
2. Tune the tone generator on a low frequency; increase it gradually and observe the behaviour of the plate and grains.
3. If the grains start to make a characteristic pattern, fine tune the frequency and make a characteristic Chladni pattern with grains centred in the node lines.
4. Increase the frequency and make further characteristic patterns with a different number of node lines (different characteristic modes).

7. Conclusion

The use of created experiments was verified in the practice. It was discovered that acoustic experiments in the teaching process increase the level of clearness of the dealt topic and also the students' attention. The experiments force the students to work and think independently and help to show the connection between physical theory and everyday life in nature, mechanics and society. Some lesson experiments were carried out practically, some as video experiments. In carrying out of experiments the students' worksheets and guidelines for teachers were available. Students were actively involved in every stage of experiments and in using video experiments the projection was sporadically sopped and properly supplemented with teacher's comments, in some cases with discussion.

The results of observations showed, that students are more attentive and active when experiments, especially the ones connected with practice and everyday life, are used. Furthermore, also such students, who are not very much interested in physics and have worse notes, are involved in experiments solving.

To conclude, our aim is to create a complex study material from the field of acoustics. This would contain teaching material, qualitative assignments and experiments. The main importance is put on the experimental element in particular. Gradually, we shall create a similar material from other fields of physics with a focus on qualitative assignments, video experiments, simulations and experiments supported by computers.

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Ren Xian-qiang – Liu Jian-yi *

FACTORS CONTRIBUTING TO FREEWAY CRASHES AND COLLISIONS: SOME MEASURES AND FINDINGS ALONG TDM IMPLEMENTATION

Freeway plays an important role in economic and social development, especially for developing countries such as China, which is also an essential issue in TDM strategy. Therefore, proper infrastructure maintenance and management are significantly necessary. Currently, accident related factors and exact effect degree are mostly conducted by human observation. Automated operation would substantially improve the processing speed and accuracy of the key processing tasks, factor detection, classification and degreeing, since the human observation of the large amount of data is tedious, error-prone and time-consuming. 2003~2005 accident data is surveyed from two typical freeways, Jiqing and Dongqing, and then rear-end collision accident is divided into two patterns, namely rear-collision and stationary object collision. PCA (Principal Component Analysis) is induced to identify the effect level of different factors on above mentioned two types of collisions, which reduces the dimension of the image as well as keeping the most important features, and significant effect factors are identified by charting analysis and clustering research. The final investigation result indicates that fatigue driving, over-speeding, environmental factor, unsafe following, truck overload, and trunk driving, over-speeding, overcrowd, fatigue driving illegal overtaking, are main effect factors on rear collisions and stationary vehicle collisions, respectively. Preliminary experimental result presented in the following demonstrates that such a proposed method has potential to solve the identification and classification problem of factors contributing to freeway crashes and collisions.

Keyword: freeway; TDM strategy; rear-end collision; principal component analysis; effect factor

Nowadays, automobiles are pouring into general urban families and becoming a need for enjoying the convenience and short-cut of modern life directly brought by technological development. However, severe social problems, such as heavy traffic congestion, environmental pollution, and traffic accidents, etc, have become one of the central and heated issues, concomitancy with the increase of automobile, among which traffic accident especially attracts the world's attention. In China, for instance, it was officially announced that more than one million people lost lives in traffic accidents in 2003, in which random rear-end and side-wiping collisions, induced by too small vehicle following gap and brake distance, cover about one-third of the total amount.

To cope with this problem, a program on Intelligent Transportation System (ITS) has been proposed to increase road efficiency and decrease the negative effect of accident-related factors and other countermeasures, both administrative and technological, have also been adopted to investigate the rules and probability of traffic accidents [1,2]. During the research, rear-end collision is considered as the main accident pattern on freeway and its occurrence regulation is considered to be a key idea affecting investigation result and result implication, specially rear-end and side-wiping collision [3,4].

Taking the 2003~2005 freeway accident data surveyed from Jiqing Freeway and Dongqing Freeway into consideration, rear-end collision accident is divided into two patterns, including rear-collision and stationary object collision. Principal component analysis (PCA) is induced to identify the effect level of different factors on two types of rear-end collisions. Then, significant effect factors are detected and chosen by charting analysis and clustering research. Such a research would have a significant effect on the occurrence of stationary object collision, which provides a reference to Freeway management departments for TDM strategy.

1. Classification of Rear-end Collision Accidents on Freeway

According to accident pattern [5], freeway rear-end collision accidents are divided into two types, including rear collision, characterized by the collision between the head of following vehicle and the rear of leading vehicle. The other is stationary object collision, which occurs between the head of following vehicle and the rear of stationary vehicle parking around the road.

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Based on above definition, accident surveyed from Jiqing Freeway and Dongqing Freeway ranging from 2003 to 2005 is classified into two types, as listed in Table 1.

Four indicators of rear-end accident pattern distribution Table 1

Freeway	Accident type	Accident Count (Times)	Death (Persons)	Injury (Persons)	Economic loss ($\times 10^4$ Yuan RMB)
Jiqing	Rear-end collision	45	34	43	93.66
	Stationary vehicle collision	7	3	9	5.75
Dongqing	Rear-end collision	53	41	33	142.68
	Stationary vehicle collision	8	2	5	9.39

Equivalent number of accidents is introduced to analyze the seriousness of different patterns of freeway accidents.

$$ER_i = K_1 F_i + K_2 J_i + R_i \quad (1)$$

where ER_i is the equivalent number of the i^{th} rear-end accident. K_1 is the weight of dead persons in the i^{th} rear-end accident. K_2 is the weight of injured persons in the i^{th} rear-end accident. F_i is the statistical number of dead persons in the i^{th} rear-end accident. J_i is the statistical number of injured persons in the i^{th} rear-end accident. R_i is the accident number of the i^{th} rear-end accident.

For the sake of simplicity [6], the weight k_1 of dead person is considered as 2.0 and the corresponding injured k_2 as 1.5. From Table 1, the equivalent numbers of each rear-end accident pattern on Jiqing Freeway are obtained as $ER_1 = 177.5$, $ER_2 = 26.5$ and the same result for Dongqing Freeway is $ER_1 = 184.5$, $ER_2 = 19.5$. Therefore, rear-end collision is the main accident pattern among freeway accidents.

2. Process of Principal Component Analysis Method

To distinguish the effect degree of above-mentioned factors for Freeway rear-end collision [7], principal components analysis method, which is a kind of statistical analysis method transferring a few of indicators into some main indicators, is used to analyze the effect degree. According to its working theory, the calculation process is divided into the following six steps [8].

(1) Data Preparation

The statistical accident data is recorded as:

$$X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix} \quad (2)$$

(2) Data standardization

Accident data is standardized by Z - score as:

$$x_{ij}^* = (x_{ij} - \bar{x}_j) / \sigma_j \quad (i = 1, 2, \dots \text{ and } j \Rightarrow 1, 2, \dots, p) \quad (3)$$

where:

$$\bar{x}_j = \sum_{i=1}^n x_{ij} / n \quad (t = 1, 2, \dots, n) \quad (4)$$

$$\sigma_j^2 = \frac{1}{n-1} \sum_{i=1}^n (x_{ij} - \bar{x}_j)^2 \quad (t = 1, 2, \dots, n) \quad (5)$$

(3) Correlation coefficient matrix R determination

$$R = (r_{ij})_{p \times p} \quad (6)$$

where

$$r_{ij} = \frac{1}{n-1} \sum_{i=1}^n x_{ii}^* \square x_{ij}^* \quad (i = 1, 2, \dots, \text{ and } j \Rightarrow 1, 2, \dots, p) \quad (7)$$

(4) Eigenvalues and eigenvectors of R

If eigenvalues comply with $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p \geq 0$, $a_1, a_2, \dots, p$ is the corresponding Orthogonal unit eigenvector, then the i^{th} PCA of vector X is defined as:

$$Z_i = a_i^T X \quad (i = 1, 2, \dots, n) \quad (8)$$

where Z_1 is named as the first principal component of investigated vector.

(5) Contribution rate of PCA

$$G(m) = \sum_{i=1}^m \lambda_i / \sum_{i=1}^p \lambda_i \quad (i = 1, 2, \dots, n) \quad (9)$$

(6) Result analysis

According to the analysis result, accident causes could be investigated.

3. Principal Components Analysis of Accident Effect Factor

The purpose of analyzing the effect factors is to make the quantitative analysis of the relation between each factor and the occurrence probability of rear-end collision and detect the main factors, which will provide a research basis [9].

3.1 Rear-end accidents

Four indicators of rear-end collision on Jiqing Freeway and Dongqing Freeway are surveyed over the time of 2003-2005, the result is obtained by principal components analysis method as the following.

(1) Eigenvalues and eigenvectors

$$\lambda_1 = 3.6232, \lambda_2 = 0.1837, \lambda_3 = 0.0627, \lambda_4 = 0.0329$$

The eigenvector of λ_1 is $Z_1 = (0.5121 \square 0.5246 \square 0.4678 \square 0.4905)$.

(2) Contribution rate of PCA

Suppose $m = 1$, then the contribution rate of PCA can be calculated by Eq (9):

$$G(1) = \sum_{i=1}^m \lambda_i / \sum_{i=1}^p \lambda_i = 0.9189 > 80\% \quad (10)$$

The result is more than 80 percent and indicates the feasibility of characterizing the four indicators with a comprehensive one.

(3) Analysis result

The effect force of each factor can be judged by Eq (8):

$$Z_1 = 0.5121X_1 + 0.5246X_2 + 0.4678X_3 + 0.4905X_4 \quad (11)$$

where X_i is the standardized accident data as listed in Table 2.

Four standardized indicators and evaluation data of effect factors

Table 2

ID	Effect factor	Accident count (X_1)	Dead toll (X_2)	Injuries (X_3)	Losses (X_4)	Evaluation (Z_1)
1	Over-speeding	1.9544	1.5643	2.0604	0.8278	3.2088
2	Drunk	-0.5113	-0.6187	-0.6953	-0.5824	-1.2033
3	Fatigue	1.7399	2.2537	1.8399	2.6069	4.2116
4	Truck overload	-0.1897	-0.0442	0.2968	0.7024	0.3725
5	Overcrowd	-0.5113	-0.5038	-0.5873	-0.6766	-1.1365
6	Illegal overtaking	-0.6185	-0.6187	-0.5851	-0.5711	-1.1938
7	Illegal parking	-0.8329	-0.6187	-0.6953	-0.7029	-1.4230
8	Unsafe following	0.5608	0.1856	0.0763	0.3245	0.5730
9	Illegal lane-change	-0.61848	-0.6187	-0.5851	-0.6615	-1.2415
10	Brake misconduct	-0.2969	-0.5038	-0.3646	0.0091	-0.5826
11	Vehicle effect	0.7752	0.7601	0.5172	-0.0116	1.0314
12	Pavement	-0.8329	-0.6187	-0.6953	-0.7029	-1.4229
13	Environmental factor	-0.6185	-0.6187	-0.5851	-0.5617	-1.1938

3.2 Effect factors of stationary vehicle collision

Four indicators of stationary vehicle collision on Jiqing Freeway and Dongqing Freeway are surveyed over the time of 2003–2005, and the result is obtained by principal components analysis method as

(1) Eigenvalues and eigenvectors

$$\lambda_1 = 3.6050, \lambda_2 = 0.3904, \lambda_3 = 0.0045, \lambda_4 = 0.0002$$

The eigenvector of λ_1 is $Z_1 = (0.5265 \square 0.4505 \square 0.4965 \square 0.5228)$

(2) Contribution rate of PCA

Supposing $m = 1$, then the contribution rate of PCA can be calculated by Eq (9)

$$G(1) = \sum_{i=1}^m \lambda_i / \sum_{i=1}^p \lambda_i = 0.9012 > 80\% \quad (12)$$

The result is more than 80% and indicates the feasibility of characterizing the four indicators with a comprehensive one.

(3) Analysis result

The effect force of each factor can be judged by Eq (8) as

$$Z_1 = 0.5265X_1 + 0.4505X_2 + 0.4965X_3 + 0.5228X_4 \quad (13)$$

where X_i is the standardized accident data as listed in Table 3.

Four standardized indicators and evaluation data of effect factors

Table 3

ID	Effect factor	Accident count (X_1)	Dead toll (X_2)	Injuries (X_3)	Losses (X_4)	Evaluation (Z_1)
1	Over-speeding	2.6524	1.3293	3.0077	2.8108	4.9582
2	Drunk	-0.4443	-0.4921	-0.3454	-0.4229	-0.8483
3	Fatigue	1.3262	2.2387	0.7734	1.0829	2.6570
4	Truck overload	-0.4412	-0.4887	-0.3431	-0.4201	-0.8424
5	Overcrowd	-0.4372	-0.4843	-0.3399	-0.4163	-0.8348
6	Illegal overtaking	-0.4474	-0.4956	-0.3478	-0.4259	-0.8542
7	Illegal parking	0.4315	1.2973	-0.3354	0.3074	0.8058
8	Unsafe following	-0.3974	-0.4402	-0.3090	-0.3783	-0.7588
9	Illegal lane-change	-0.4461	-0.4941	-0.3468	-0.42468	-0.8517
10	Brake misconduct	-0.4279	-0.4741	-0.3327	-0.4074	-0.8171
11	Vehicle effect	-0.4292	-0.4755	-0.3337	-0.4087	-0.8196
12	Pavement	-0.4871	-0.5395	-0.3787	-0.4637	-0.9301
13	Environmental factor	-0.4142	-0.4588	-0.3221	-0.3944	-0.7909

4 Effect Factor Choice

The purpose of analyzing the effect factors is to make the quantitative analysis of effect factors on rear-end collisions with the calculation result of evaluation indicators, which will provide the

basis for the relation judgment between each factor and the occurrence probability of rear-end collision.

4.1 Effect factor of rear-end accidents

Using charts and cluster analysis methods to choose the effect factors behind the accident, then the main effect factors can be selected.

(1) Chart method

The chart is a more commonly used method with the simple, direct, easy to understand features. Effect factors acquired by principal component analysis are sorted according to size, then the evaluation index chart is drawn, as shown in Fig. 1.

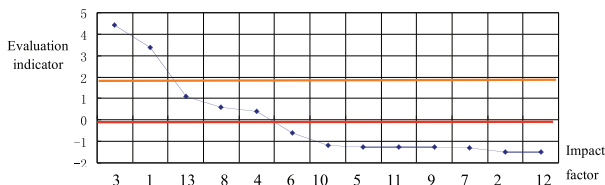


Fig. 1 Effect factor evaluation on rear-end collision on freeway

From Fig. 1, design elements are divided into three types according to the curve trend, then 0 and 2 are chosen as thresholds.

(2) Clustering analysis

The basic idea of clustering analysis is to classify each research object in a category and combine the two that are most similar with each other, then calculate the distance and similarity between a new category and other categories. This process continues until all objects are classified as a category.

With SPSS, Fig. 3 shows the result of clustering analysis.

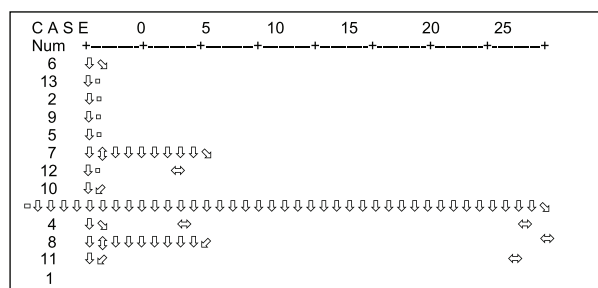


Fig. 2 Hierarchical clustering result

Supposing the linking level is 5, then effect factors on rear-end accidents are classified into three types by Fig. 2.

(3) Result analysis

By chart analysis in Fig. 1, three types are acquired. The first is fatigue driving and over-speeding and the second includes environmental factor, unsafe following, and truck overload.

With clustering analysis, three types are also acquired. The first is fatigue driving and over-speeding and the second is vehicle factors, unsafe following distance, and truck overload. Then the third includes improper brake, passenger overloading, illegal overtaking, environmental factors, drunk driving, illegal lane-change and pavement conditions.

The analysis result indicates their consistency. To the comprehensive analysis, the outstanding five effect factors are chosen as fatigue driving, over-speeding, vehicle factors, unsafe following distance and vehicle overload.

4.2 Effect factor of stationary vehicle collision

Using charts and cluster analysis methods to choose the effect factors behind the accident, then the main effect factors can be selected.

(1) Chart method

Effect factors acquired by principal component analysis are sorted according to size, then the evaluation index chart is drawn, as shown in Fig. 3.

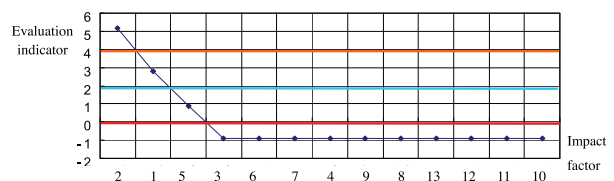


Fig. 3 Effect factor evaluation on stationary vehicle collision on freeway

From Fig. 1, design elements are divided into four types according to the curve trend, then 4, 2 and 0 are chosen as thresholds.

(2) Clustering analysis

With SPSS, Fig. 4 shows the result of clustering analysis.

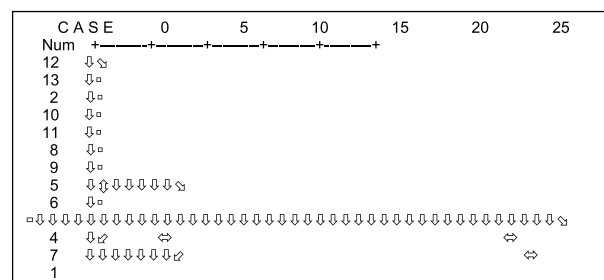


Fig. 4 Hierarchical clustering result

Supposing the linking level is 5, then effect factors on rear-end accidents are classified into four types by Fig. 4.

(3) Analysis result

By chart analysis in Fig. 3, four levels are acquired. The first is trunk driving, the second is over-speeding, the third is overcrowd, and the forth includes fatigue driving, illegal overtaking, illegal parking, truck overload, illegal lane-change, unsafe following, environmental factors, pavement, vehicle effect, and brake misconduct.

With clustering analysis, four types are also acquired. The first is over-speeding driving, the second is fatigue driving, the third is illegal parking and the forth includes improper brake, passenger overloading, illegal overtaking, environmental factors, drunk driving, illegal lane-change and pavement conditions, vehicle factors, unsafe following distance and truck overload. The analysis result indicates their consistency. To the comprehensive analysis, the outstanding three effect factors are chosen as over-speeding, fatigue driving and illegal parking.

5. Conclusion

Evaluation indicators are investigated to analyze the effect factors on rear-end accident and stationary vehicle collision by the principal component analysis method. Our preliminary data shows that based on the methodology integrated with PCA algorithm, the accident features could be effectively extracted and the effect factors can be classified with a promising accuracy. By chart comparison and clustering analysis, the main effect factors on rear-end accident on freeway are identified as fatigue driving, over-speeding, environmental factor, unsafe following, and truck overload. However, trunk driving, over-speeding, overcrowd, fatigue driving and illegal overtaking are detected as the main effect factors on stationary vehicle collision on freeway. Further work will consider other feature extraction techniques combined with SVM model.

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Jun Hai-min – Pei Yu-long *

NEURAL NETWORK OPTIMIZED BY GENETIC ALGORITHM OF MODELS FOR REAL-TIME FORECAST OF TRAFFIC FLOW

Short-term traffic flow forecast plays an important role in transit scheduling. A high-order generalized neural network model is constructed to actualize dynamic forecast on-line and a hybrid genetic algorithm and identical dimension recurrence idea are performed to optimize the structure and shape of neural network dynamically so as to enhance its forecast accuracy. With data collected from Dazhi Str., Harbin as the system input, the experimental result indicates that the average relative error of forecast is 5.53% and the maximum is less than 21%, which proves that the proposed neural network model can satisfy the precision request, accelerate the convergence speed, improve the global generalization ability and possess the practicality in short-term traffic flow forecast.

Key words – traffic flow forecast; neural network; genetic algorithm; relative error

1. Introduction

Real-time dynamic traffic assignment is the main theory base in Intelligent Transportation System, while real-time traffic volume predicting is the precondition of dynamic traffic assignment. The result of traffic volume predicting is relative to traffic assignment, so how to predict traffic volume precisely [1-3] is the starting point.

By far, many statistical methods, i.e. multiple linear regression, stochastic time series, general exponential smoothing etc. have been used for traffic flow forecast. However, as a joint-effect result of weather and traffic environment, etc, its transfer regularity always reveals the representative complexities and nonlinear characters and fails to yield satisfied results [4]. For the past few years, artificial neural network attracts intensive attention and is proposed as a powerful computational tool to solve the complex problem, such as short-term traffic flow forecast.

Traditional forecasting techniques cannot generate accurate results under an environment with high complexity, randomness and non-determinacy, because they don't have self-adaptive and self-learning functions [5, 6].

Recent wavelet neural network, as another fruitful technique combining the merits of neural networks with wavelet analysis, has been widely used in forecast [7]. Since wavelet behaves excellent performance in non stationary signal analysis and non linear function modeling, the wavelet-based neural network can provide much higher availability of convergence for approximation than ordinary multi-layer networks.

2. Traffic Flow Prediction Model

2.1 Model Choice

Traffic volume shows the complexity at intersections, because of traffic flow itself and the structure of road network [8]. Owing to high complex and variety with time, it is hard to get precise equations and label it. So we aim to get forecasting models using neural network technique and adaptive forecast traffic volume.

An artificial neural network, consisting of plenty of neurons whose broad links each other, is a nonlinear dynamic system. It is generated basing on the study of organize configurations and behavior characteristics in biologic neural system. It has been testified theoretically: a three layer neural network can achieve all kinds of complicated non-linear maps. So we found models and predicted them adopting a three layer neural network which has a certain hidden layer according to relativity of traffic flow in an intersection.

2.2 Structure of Neural Network

As the traffic flow has complex time varying and non-linear characteristics, we found a prediction model to satisfy the need for a real-time dynamic traffic assignment adopting the high-order neural network, as shown in Fig. 1.

The network training process is as follows

- 1) The forward calculation process calculates the output state of every layer neuron, at last we get the real output of the network.

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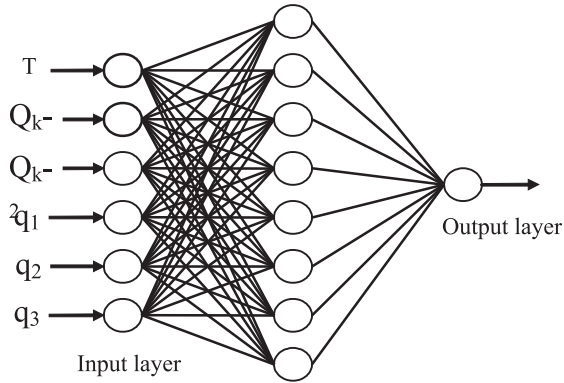


Fig. 1 Structure of neural network for traffic flow forecast

Here, we have get the optimal network nodes, that is 8, we choose a as 0.7 [9].

Suppose $w_{ij}^{(h)}$, $w_{jk}^{(o)}$, $f_j^{(h)}$, $f_k^{(o)}$ are the weights from the input layer to the hidden layer and from the hidden layer to the output layer and the adaptable Sigmoid parameter of the hidden layer and output layer neurons; then the input of hidden layer neurons

can be expressed as $u_j^{(h)} = \sum_{i=1}^n w_{ij}^{(h)} \cdot o_i$ and the output of hidden layer neurons is given as $o_j = f_j^{(h)}[u_j^{(h)}]$.

The input of output layer neurons is presented by $u_k^{(o)} = \sum_{j=1}^n w_{jk}^{(o)} \cdot o_j$ and the output of output layer neurons can be calculated through $y_k = f_k^{(o)}[u_k^{(o)}]$.

2) learning process according to the flowing equations, we adjust the network weight

Here the node state error and node reverse transfer error of output layer neurons can be obtained as $\epsilon_k^{(o)} = t_k - y_k$ and $\delta_k^{(o)} = \epsilon_k^{(o)} \cdot f_k^{(o)'}(u_k^{(o)})$.

For hidden layer neurons, the node state error and node reverse transfer error are defined as

$$\epsilon_j^{(h)} = \sum_{k=1}^m \delta_k^{(o)} \cdot w_{jk}^{(o)} \quad (1)$$

$$\delta_j^{(h)} = \epsilon_j^{(h)} \cdot f_j^{(h)'}(u_j^{(h)}) \quad (2)$$

In the same meaning, we resume η is learning ratio, P is style-book gross and define $\Delta w_{ij}^{(h)}$ and $\Delta w_{jk}^{(o)}$ are separately the adjust quantity of weight from input layer to hidden layer and from concealed to output layer, which can be expressed as

$$\Delta w_{ij}^{(h)} = \eta \cdot \sum_{p=1}^P (\delta_{pj}^{(h)} \cdot x_{pi}) \text{ and } \Delta w_{jk}^{(o)} = \eta \cdot \sum_{p=1}^P (\delta_{pk}^{(o)} \cdot o_{pj}).$$

The following equation is the adjusted quantity of adapted parameter in the learning process:

$$\Delta a = \beta \cdot \epsilon \cdot x \quad (3)$$

where ϵ is node state error, β is adjusted ratio of parameter, Δa is adjusted quantity of parameter.

In the training process, one of the key works depends on how to obtain the network weigh quickly and effectively. Upon this requirement, we induce genetic algorithm (GA) to optimize the weigh value as the following section.

2.3 Weigh Optimization by GA

The next problem is to conform hidden layer nodes. If there is no sufficient hidden layer nodes, it won't converge in learning process; if the number of hidden layer nodes is excessive, the network performance declines. The traditional BP algorithm conforms the number of hidden layer neurons on the basis of experience or examination; here we adopt a GA model to optimize the number of hidden layer neurons [10].

The GA approach, which is based on analogy with a natural selection and population genetics, is a kind of search method that was developed by John Holland. One normal application of GA is for searching an approximate solution to difficult optimization problems. However, local minimum value if the optimization function has a complex structure. In this paper, one of the main works is to find the optimization solution with a hybrid method, a genetic algorithm combined with a local heuristic search to offset the deficiency of the conventional genetic algorithm, for the network weigh [11].

Network parameters β , w^h and w^o can be reached by minimizing an energy function, which is performed by the least-mean squares theory for data series representation.

$$\text{Min}E(\beta, w^h, w^o) = \frac{1}{2} \sum_{j=1}^n \sum_{i=1}^m [\tilde{y}_{ij}^k - y_{ij}^k]^2 \quad (4)$$

where $\tilde{y}_{ij}^k$ and y_{ij}^k are the j -th desired and real obtained outputs with respect to the i -th input data.

The hybrid genetic algorithm involves initialization, mutation, competition and selection. An initial population is selected to initialize the parent generation according to a uniform distribution. In initialization, encoding takes on significant task and each population expressed by encoded chromosome stands for a certain solution to a required question.

A multi-valued encoding pattern is used to obtain a solution. A chromosome is divided into four segments: three of them are parameter segments, which are encoded in real values to deliver the information about the translation factor, telescopic factor and weight factor of the hidden unit. Simultaneously, the fourth segment is to encode the structure character in binary, where 1 represents a valid hidden unit, and 0 shows it is ineffective.

Each evolution generation is assigned a fitness value in accordance with the given fitness function

$$F(\beta, w^h, w^o) = \frac{1}{\sqrt{[\bar{y}_k^{ij} - y_k^{ij}]^2}} \quad (5)$$

since the most commonly used objective function aims to obtain the least error series between statistical data and forecast value.

Offspring is created from their parents by a composite mode. An encoding pattern of cross-gene is firstly judged and linear combination is used in a crossover operation for cross-gene encoded by real value. If x_i^g and x_j^g are defined as respective parent individual, the corresponding offspring through crossover is formulated by

$$x_i^{g+1}(P) = \lambda \cdot x_i^g(P) + (1 - \lambda) \cdot x_j^g(P) \quad (6)$$

$$x_j^{g+1}(P) = \lambda \cdot x_j^g(P) + (1 - \lambda) \cdot x_i^g(P) \quad (7)$$

where λ is an evolution rate complying with $\beta^0 = 0.9$

Here, g and p separately represent a generation number of evolution and position of crossover gene. However, a conventional single-point crossover is preferred to further evolution, if crossover gene is encoded by binary.

Mutation is also treated with a different encoding mode and the mutation position encoded by real value yields the following mutation model

$$x_i^{g+1}(P) = x_i^g(P) + \delta \cdot E(x_{max}) \cdot P_m \quad (8)$$

where δ is a stochastic value ranging over $[-0.5, 0.5]$ and represents the cumulative value of a squared error derived from the chromosome with maximum fitness when evolving into the g -th generation and P_m is a mutation factor to control the mutating operation.

If the binary encoding is applied, offspring is generated from their parents by a Gaussian perturbation

$$x_i^{g+1}(P) = \lambda \cdot x_i^g(P) + N(0,1) \cdot P_{pi} P_m \quad (9)$$

where $N(0,1)$ denotes a normally distributed one dimensional random variable with mean zero and standard deviation. To a total population pop, P_{si} is the the i -th proportion factor

$$P_{pi} = \frac{F_{max} - F_i}{\sum_{i=1}^{pop} F_i} \quad (10)$$

The following parts (contents/factors) should be noted above all. The gradient descending factor, which holds the same iterative step-size with the evolution process, optimizes the network parameters without remodeling the structure of WNN and characteristic gene of optimized chromosome has to answer the limited scope, such as dilation factor. The next evolution group, conserving diversity of population through reproduction and competition, consists only of filial generation derived from crossover and muta-

tion, due to inheriting the unparalleled quality from paternal generation.

In the hybrid genetic algorithm, competition and selection lead to more adaptive generation through a given proportion, which inevitably causes premature or slow convergence. Here, the evolving principle is executed through optimum reservation strategy combined with proportion selection. All population is sequenced with ascending sort on the basis of fitness, among which chromosomes with large fitness will be assigned directly into the next generation. Otherwise, the above proposed evolving procedure has to be reduplicated via a selection factor

$$P_{si} = \frac{F_{max} - F_i}{\sum_{i=1}^{pop} F_i} \quad (11)$$

The selection factor assures the chromosome with low fitness to gain large probability in the next generation. However, evolving population is sometimes logging into a certain individual or such finite ones, which is usually named local convergence and reduces the probability of global optimum. Therefore, the distance between two individuals is significantly taken into account in selection operation and one individual has to be eliminated correspondingly due to a shorter distance.

3. Case Study

The following is an example of the optimized neural network framework using the real traffic volume data of the intersection of West Dazhi Str. in Harbin in Oct. 12~18, 2006. We used one-week traffic volume data to train, and Figs. 3, 4 are error variety curves with the increase of genetic step and variety process of hidden layer nodes with the increase of genetic step, respectively.

To determine a proper β , w^h and w^o , the following simple scheme depends on proposed GA approach mentioned in section 2.3.

- 1) Pre-processing the input data series through fuzzy reasoning theory.
- 2) Generating the original population within a logical interval.
- 3) Utilizing crossover and mutation operations.
- 4) Creating new offspring via optimum reservation and proportion selection.
- 5) Sequencing the individuals by fitness and computing the distances between chromosomes.
- 6) Finishing the search process, if it satisfies the stopping rule, or going back to step III.
- 7) Real-time and dynamic forecast with identical dimension recurrence.

We train the neural network also using above traffic volume data when the objective is close to extreme. If we increase the learning ratio, the training time will decrease. So we design a variable learning ratio based on a genetic step and grads value, accelerating convergence speed. The training process with a proposed high-order generalized neural network; the training time is 894.02s,

that is about 15min, after that we get the network weight w_{ij} and w_{jk} by adaptable GA consideration, as from Fig. 2 to Fig. 5.

From the prediction result it can be seen that the average absolute error is 41, the maximum absolute error is 182; it is at the time interval 27. Figs. 4, 5 show the forecast error and average relative error is 5.53%, and thus we reach the maximum relative error 20.63%, at the time interval 19.

3. Conclusions

A considerable amount of experiences were gained through developing an improved neural network model to forecast the short term traffic volume in real-time traffic control. The experience leads to the following recommendations.

- 1) A multiple layer neural network model with learning function is discussed, for short term traffic flow prediction, and its struc-

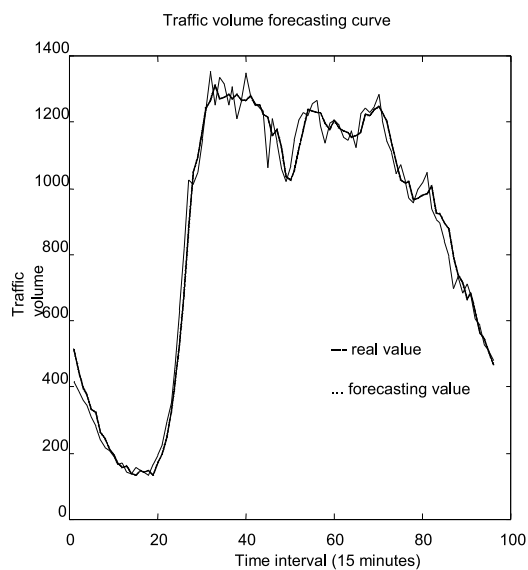


Fig. 2 Statistical and forecast volume of traffic flow

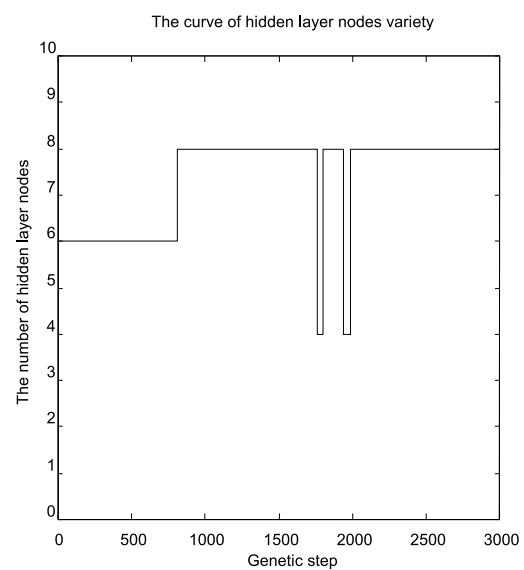


Fig. 3 Variety of hidden layer during training process

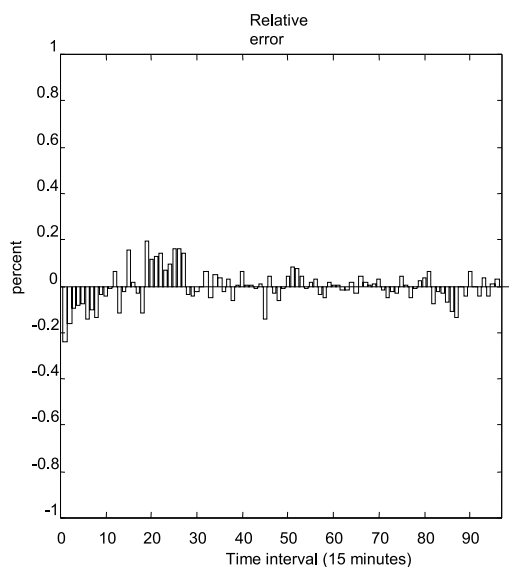


Fig. 4 Verification of relative error of traffic flow forecast

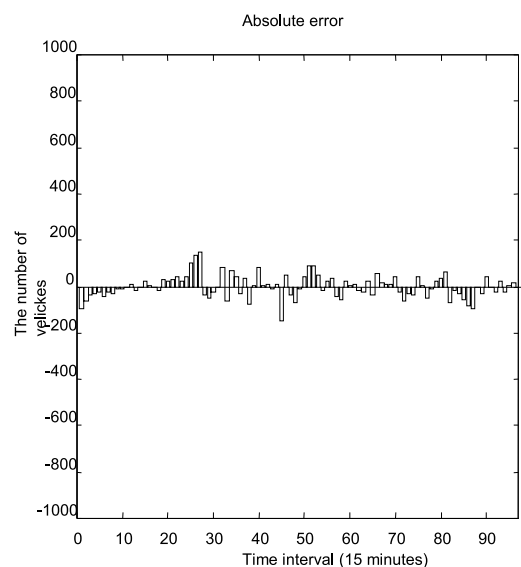


Fig. 5 Verification of relative error of traffic flow forecast

ture and working effectiveness depend on the optimization of three parameters, the weigh w_h and w_o , and the adjustment coefficient.

- 2) Hybrid genetic algorithm is introduced to optimize the parameters and structure of constructed neural network model. The experimental result indicates that the proposed neural network model optimized by the hybrid GA has fast convergence and high-accuracy ability.
- 3) Since traffic volume exists in the dynamic system of traffic and transportation, we can precisely forecast the traffic volume within several seconds, thus calculate travel time or obstruct function of a vehicle based on the traffic volume, ultimately plan the shortest route of every vehicle, in other words, guide the vehicle to move along an optimal route. This will significantly enhance efficiency of the whole traffic system, i.e. reduce traffic jams, save travel time, etc.

- 4) For future research it would be of interest to investigate factors affecting traffic flow and more optimization algorithms for real-time forecast to construct a practical operation system for dynamic traffic control and management.

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