GenAI as a Tool for Content Generation in Hypermedia Edutainment Applications: Potential and Limitations

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Keywords: Crossmedia Storytelling, Hypermedia Edutainment, Personalization, Generative AI.

Abstract: Generative AI can considerably speed up the process of producing narrative content including different media. This may be particularly helpful for the generation of modular variations on narrative themes in hypermedia, crossmedia, or transmedia contexts, thereby enabling personalized access to the content by heterogenous target groups. We present an example where GenAI has been applied for image creation and translation of a text to multiple languages for a crossmedia edutainment project transferring IT security knowledge to vulnerable groups. GenAI still seems inadequate to produce interesting narrative text integrating dedicated educational content. AI-generated illustrations often require manual rework. However, LLM support in multilingual translations displays more intelligent solutions than expected, including the implementation of a password generation process from a narrated description.

1 INTRODUCTION

Generative Artificial Intelligence (GenAI) has brought about a quantum leap to a broad variety of Information Technology (IT) services related to the production of media content. Especially for the production of multimedia narratives GenAI tools like ChatGPT, Stable Diffusion, etc. offer support that bears the potential to speed up the creative process significantly.

We have developed an environment for delivering information related to Cyber Security especially to vulnerable groups like elderly people following a crossmedia approach that includes human "mediators" and traditional media (hardware) as well as a hypermedia edutainment platform (Heiden et al., 2023). The edutainment approach is to subliminally integrate educational content in an entertaining narrative (Heiden et al., 2024). Personalization is an important issue, since the target groups vary considerably in many aspects, for example: personal preferences, previous knowledge, time constraints, or cognitive abilities. Therefore, an edutainment product on a single topic should be offered in multiple variations, whose production would usually cost much time and effort.

1.1 Motivation

When creating edutainment material, it is important to find the right balance between the educational content as the core of information that shall be transported to the users with an entertaining framework as its vehicle. Acceptance by the target group (and thereby educational success) largely depends on this balance as well as on a seamless integration of both aspects. Although Large Language Models (LLMs) like Open AI's ChatGPT can help to gather and summarize information for the educational content, its correctness must still be checked thoroughly by human experts. Embedding this content in an interesting and entertaining narrative that reaches people who are rather reluctant to teaching offers like seminars, workshops, or online resources requires creative skill. Due to the already mentioned personalization requirements, the edutainment products have to not only be technically

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Heiden, W., Saitova, V., Kless, T., Wegner, V., Rötter, D. and Neteler, T.
GenAI as a Tool for Content Generation in Hypermedia Edutainment Applications: Potential and Limitations.
DOI: 10.5220/0013298100003932

In *Proceedings of the 17th International Conference on Computer Supported Education (CSEDU 2025) - Volume 1*, pages 444-451
ISBN: 978-989-758-746-7; ISSN: 2184-5026

correct but also tailored to the varying preferences between and even within the different target groups. Variations can be related to many aspects like narrative genre, length/duration, media format, language, or linguistic style. Creating the narrative first as a generic elementary structure and then producing variations on the theme, partially enriched by multimedia artwork and/or interactive components is a challenging task not only in terms of creative potential but also by sheer expenditure of time. This is laborious and requires a large number of personnel if done manually. Since the process of creating such additions to an existing framework is repetitive, it lends itself to the use of generative AI tools.

1.2 Research Gap

Despite their unquestioned impressive capabilities, there are still considerable limitations of AI systems in general and text generating Large Language Models (LLMs) in particular. These limitations must be considered thoroughly before giving away LLM output - especially but not limited to when it is designed to transport trustworthy information. For example, LLMs have been found to produce a bias when summarizing newspaper content (Fang et al., 2024). There is also evidence that LLMs may give citations to non-existing references (Day, 2023). It has recently been shown that AI systems trained on databases with a considerable percentage of AI-generated content tend to produce lower quality output (Shumailov et al., 2024).

Our focus is on the creative potential of GenAI systems. Although there is an ongoing hype to use GenAI for narrative creation including a discussion about its role as either autonomous or supporting tools (Fisher, 2023) and to explain how it works (Brüns and Meißner, 2024), there is currently no structured study about how and to which extent these tools can raise the efficiency of the creative process in terms of producing a large number of variations on a narrative theme.

1.3 Research Questions

Within the scope of our study which primarily aims at designing and installing a crossmedia edutainment environment for teaching IT security to vulnerable groups, we have evaluated the usefulness of GenAI for supporting the generation of a variety of narrative modules related to a common topic. We thereby wanted to find answers to the following questions:

1. How and to which extent can GenAI support the creation of an entertainment framework that embeds educational content resulting in edutainment stories?
2. What are the practical limitations of this approach?

1.4 Method Summary

We created an edutainment artefact by combining an initial version of an entertainment framework using a story that includes educational content. This initial version is then altered by GenAI tools with different goals. Their output is checked by humans on their level of quality, how well the process could support creative personnel, and if the educational content is unaffected by the alterations. GenAI tools are used to create supportive imagery based on the text of the stories and to translate the stories into different languages. To somehow quantify the quality of translation, we counted the words that were changed by human inspectors (native speakers) when these were asked to check the AI translations and improve the linguistic quality. The time gained by GenAI support was measured by comparing the temporal effort it took a human author to perform a selected task component with the overall time required for a comparable task with support by AI tools, also including human rework in post-production.

2 RELATED WORK

Transmitting information through stories has a long tradition going over millennia. However, after storytelling as a means of delivering information has been largely replaced by various other media, it has survived in entertainment and is now going through a renaissance with edutainment or infotainment.

It is well-known that information is better and more permanently received when it comes along with emotion (Kensinger, 2009) and when it enters the human mind through more than one sensory channel (Ponticorvo et al., 2019). Edu-/infotainment plays a particular role for reaching people that are reluctant to actively seek advice or to make use of educational offers even when a topic of general interest is concerned.

We found this reluctance in elderly people regarding IT services in general due to a feeling of low self-efficacy. Therefore, we are looking for a way to teach these people important lessons on IT security that could enable them to safely benefit from digital health or financial services without fear of falling victim to cyber-attacks. We chose an edutainment approach that subliminally transports knowledge as

well as confidence through stories accessed primarily for entertainment (Heiden et al., 2024).

We also found a broad variety of preferences for different genres and media within our target group, in addition a broad range of previous knowledge and interest in cyber security topics. Therefore, we decided on an approach to enable access to IT security to elderly people through crossmedia storytelling (Heiden et al., 2023). This includes personal readings in front of an audience as well as media hardware (printed booklets, audio CDs, etc.) and an online repository with the structure of a Hypermedia Novel (HYMN) (Heiden, 2006).

Offering different types of stories via different media in different languages and with variation of several parameters enables a personalized access to the content for everyone. However, these personalization options require a lot of creative effort to produce multiple storytelling products.

We focused on the topic of passwords for our initial storytelling, because an interview study with our target group indicated issues in handling secure and memorable passwords in everyday activities (Heiden et al., 2023). This coincides with the surveys of the public; some people have issues with understanding the potential attack vectors with passwords (Ur et al., 2016). Our target group is especially vulnerable to knowledge gaps. First interviews revealed that a large percentage of the questioned elderly persons had not dealt with the topic until they were forced into the digital realm by external factors like financial services or online shopping. Therefore, we aim to equip these people with beginner information about passwords in a way that can be consumed as entertainment media.

The area of password generation is well researched (Adams et al., 1997; Tan et al., 2020) and has recently also included the use of GenAI (Umejiaku et al., 2023). As password security and memorizability are only used as an example for the learning content within an edutainment narrative, it is by itself not in the focus of our study and therefore not addressed in detail in this report.

3 AI SUPPORT FOR STORYTELLING

Creating narratives is hard work and takes its time. A large variety of successful text and television series proves that skilled and experienced (teams of) authors can produce fiction in a kind of production line on a weekly or even daily basis. However, creating high quality narratives both interesting and educative (and technically correct) while keeping within given constraints (e.g. in terms of length), additionally enriched by different media and branching into variations for several aspects of personalization, would require a considerable amount of time and effort from both authors and scientific experts. Covering a significant number of relevant topics for the vulnerable target groups may well cost so much time that the provided information might be outdated before the material is available. Therefore, we used generative AI (GenAI) tools to support the creation and variation of the content.

In order to disseminate the subliminal information as widely and efficiently as possible, we have tried AI tools for the generation of text, images and translation of the stories into several languages. Our evaluation of these studies indicates that AI can be useful to quickly produce supporting media and translation drafts which, however, still require some human rework before being applicable. Despite this post-processing requirement, the use of AI as a tool still speeds up the production process of story variations significantly, thereby supporting personalization of access to the information for different people with different preferences and constraints.

We found GenAI not yet ready to autonomously produce stories that match our requirements to be both interesting and informative, of adequate length and with dedicated learning content seamlessly integrated in the story. However, it proved to be a useful tool for efficiently modifying an existing story to adapt it to different target groups. We used GenAI to generate narrative personalization of our baseline story framework to build a rich set of options users can choose from.

3.1 Image Generation

Every story should have a frontispiece. To attract attention and trigger an urge to look inside, it should not just be any cover picture but rather one with “eye-catcher” quality. GenAI today can produce images of impressive quality from textual description (“prompts”) that artists formulate based on their imagination. Many tools with several comparable and some differing strengths and weaknesses are available for free or payment, most of them online and some even free to install locally. Among those image creation AI-tools are DALL·E, Stable Diffusion, Craiyon, Midjourney, NightCafe, and AI Mirror, just to name a few. Despite their compelling abilities, these tools still have some limitations (Ye et al., 2024).

Typical aberrations in AI-generated pictures are related to anatomical details or neglecting explicit positive or negative prompts. Objects in images may appear differently than the prompts suggest, and removal of objects alters the image in unexpected ways, such as changing unrelated objects in addition. Although we suspect that those issues will most probably vanish sooner rather than later considering the tremendous advances that become visible from one AI version to the next, current GenAI tools often still require human rework on details before a picture is ready to serve as a cover image for a story (or an internal illustration). There is, however, no doubt that GenAI can instantly produce images of considerable visual quality, especially if no professional artists are involved. Post-processing like selecting an image out of a pool of AI-generated suggestions and fine-tuning, for example correcting some anatomical details such as the number of fingers then takes minutes instead of at least hours to produce an entire picture.

Some free text feedback from our questionnaires indicates that there is an interest within our target group for more extensive illustration of the stories by inside pictures (or even a graphic novel version). Consistency of recognizable characters between different pictures is currently another weakness of image-producing GenAI, but there are already promising approaches to cope with this problem (Martini et al., 2024).

3.2 Text Translation

GenAI using Large Language Models (LLM) like ChatGPT, LLaMA or Claude are quite good at translating text from one language to another. There are even GenAI tools specialized on translations like DeepL. We have used ChatGPT 4.0 to translate our crime story from German to English and Russian using the following prompts, respectively: "Translate the following into English: *[Then the entire German original text of the story named „Der Stick des Todes" was given]*" (which resulted in an output with the title "stick of death") and "Please translate "stick of death" to Russian additionally". After we found several severe errors in the first Russian translation attempt, a second try delivered a more useful result. The English translation has been reworked by the author of the original story and additionally by a native speaker (U.S. American) and checked for consistency with the original. The Russian translation has been reworked by one of the authors (who is a Russian native speaker and a scientist working in the research project) and compared with a translation of the original text done by a human professional translator.

3.2.1 Translation from German to English

Comparing a translation of the crime story from the German original into English by ChatGPT with a revised version of this translation, we found that – apart from stylistic considerations – only few corrections were necessary. Most of the required changes were related to puns or untranslatable proverbs.

An approach to quantify the translation quality by counting the words that had to be changed in the revision process shows that only about 5 % were changed to end up with a correct and well-readable text. We are aware that this quantification approach may not meet hard scientific standards, since only few changes would have been necessary in terms of maintaining the original meaning of the text, while others are rather of a linguistic nature or depending on personal preferences for stylistic aspects. It should, however, give at least a general impression of how much time and effort can be saved by replacing human workload for a first translation iteration by GenAI.

3.2.2 Translation to Russian

The translation to Russian by ChatGPT 4.0 produced a result that required rework on about 30 % of the words generated by the LLM using the same quantification approach as for the English text. We reviewed the LLM translation twice. It was reworked separately by a native speaking scientist and a professional translator. We found that the above-mentioned percentage of rework is valid for both versions.

3.2.3 Other Language Variations

To switch our target group from elders to youths with a non-academic background, we have also tried to make ChatGPT translate the text to a simplified wording. This attempt only created a summary of the story which was written in simple language but missed the informative content. Another attempt to make ChatGPT shorten the text by half did quite a good job keeping the relevant information while only producing a few consistency leaks that could easily and quickly be mitigated by reinserting a few sentences from the original text without thwarting the condensation significantly.In comparison, shortening the original text from a reading duration of 60 min to

45 min manually required about 2 hours work by the author.

We also found that GenAI can be very helpful to illustrate a story with accompanying pictures (which was a suggestion from one participant of our study to make the reading more relaxing). However, even with thorough iterative prompting it was impossible to get an image that did not require at least a little manual revision to reach a status ready for publication together with the story.

3.2.4 Artificial Intelligence?

While the classical "Turing Test" (Turing, 1950) poses no challenge to nowadays' chatbots, there is still an ongoing debate over LLMs actually understanding the content of textual descriptions (Mitchell and Krakauer, 2023). LLMs generating text are rather considered as a kind of "digital parrot" not aware of the meaning of what they seem to "say", since the underlying algorithms are driven by statistical analyses of text elements appearing close to each other in a vast database of example text used for their training (Zhao et al, 2023). Although these chatbots produce text output in high quality that is even able to successfully pass academic examinations in almost every scientific discipline (Sadeq et al, 2024) or give explanations and summaries of informative texts that are helpful to students and teachers alike, these systems are therefore mostly not considered "intelligent" in a human-like fashion.

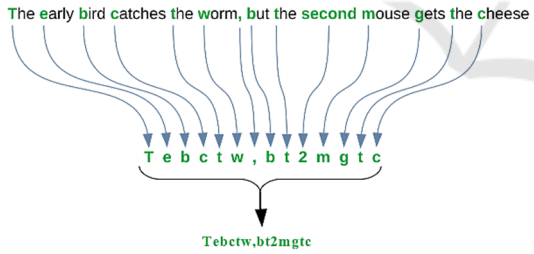

Figure 1: Password generation from a passphrase. The example is based on an extended proverb. The first character (major or minor) of each word is used, special characters are copied, words describing numerals are used as numbers.

It is remarkable that in our studies ChatGPT was able to detect and (partially) adopt the described algorithm for the generation of a secure and memorable password from a phrase (see Figure 1), although it was unable to realize the use of puns in some chapter titles and thus translated these word by word, thereby losing the original meaning of the play on words. For teaching password security topics in our story, we used an extended version of a traditional German proverb (which has a direct equivalent in English but not in Russian) to explain the generation of secure yet memorable passwords from a "passphrase". In the story, the passphrase eventually leading to a strong password is generated in three phases: (1) The origin is the well-known proverb "Der frühe Vogel fängt den Wurm" (The early bird catches the worm), which is then (2) extended by the (inofficial) follow-up "… aber erst die zweite Maus kriegt den Käse" (… but only the second mouse gets the cheese), thereby prolongating the term and adding a numeral ("second" becomes "2"). (3) An exchange of the word "Käse" (cheese) by "Speck" (bacon) and a closing exclamation mark finally introduces a variation on the standard proverb and adds a special character.

As an intermediate result, combining the original sentence (phase 1) with the extension by a comma, the German phrase: "Der frühe Vogel fängt den Wurm, aber erst die zweite Maus kriegt den Käse" was originally explained leading to the following password by taking the initial character of each word (in its original case) unless it is a number which is then converted to the according numerical character: "DfVfdW,aed2MkdK". The phrase was translated (more or less) correctly by ChatGPT to "The early bird catches the worm, but [only] the second mouse gets the cheese" and "TEBCTW,BTSMGC", respectively. It is interesting that the GenAI recognized the relation between the passphrase and the password, but – unlike the original – used only capital letters for transformation to a password and lost the "t" from "the" before "cheese". The comma added to the resulting password in the German original when combining the two parts of the phrase was kept in the English translation although it was only mentioned in the text but not explicitly written in a modified repetition of the phrase. However, ChatGPT seems to overlook the rule to transform the word "second" into a number ("2"). When finally adding an exclamation mark in the end in the German original after the word "Käse" (cheese) had been replaced by "Speck" (bacon) to enhance the passphrase's complexity (eventually resulting in "DfVfdW,aed2MkdS!") the translation seems to get confused and changes the final password to "TEBCTW,BTSMGW!", losing the correspondence to the phrase of origin at the end without following the exchange that should have lead from "c" to "b". It should be mentioned that again both additional changes were only explained in a dialogue within the story, where the finally resulting password was then given without prior explicit reformulation of the entire phrase as its direct origin.

In the Russian translation, where no literally analogous proverb exists, ChatGPT translated the first (traditional) part of the sentence word by word and therefore equivalent to the German (and English) version: “Ранняя пташка ловит червяка“. The extension, however, is translated analogously to the English version: “но вторая мышка получает сыр“. When producing a password from the entire sentence, ChatGPT differs from the English translation in skipping the comma as well as the following word (но/but) but implementing the switch from the word “вторая/second“ to the numerical character “2“: “Рплч2мпс”. When finally the exclamation mark should be added (together with the cheese/bacon exchange), unlike in English, this is done by ChatGPT correctly with a change from “с” (сыр - cheese) to “б” (бекон - bacon): “Рплч2мпб!“.

The entire procedure comparing the original and the translated versions with the correct implementation, and as generated by ChatGPT is illustrated in Figure 2.

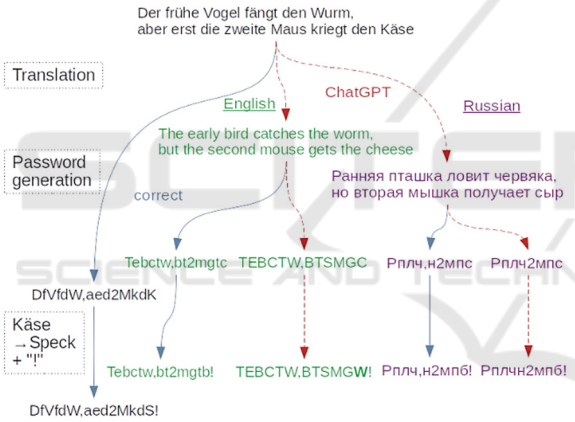

Figure 2: Password generation from a passphrase based on a German proverb. The original text has been translated to English and Russian by ChatGPT 4.0, which then also estimated the resulting password. The correct deduction of a password from the phrase following the given textual description (blue arrows) is compared to the results produced by ChatGPT (red arrows).

These observations lead to the impression that the LLM has achieved more than to only put together linguistic elements that fit together well in terms of syntactic rules and semantic content but also don’t require a true understanding of the original text. To perform the transformation from passphrase to password – even though not completely flawless – it had to somehow extract the underlying algorithm either from the explanation given in the text or by deduction from the implicit relationship between passphrase and password in the original text.

The English translation as evaluated in detail in the above sections was generated by ChatGPT 4.0 in May 2024, the Russian translation 10 days later. In November 2024, we asked ChatGPT 4o to translate the German original again to English and Russian and additionally to French and Spanish. In the resulting text versions, we placed our focus on how the LLM translated the passphrase (including its extension but no further changes) and on which password it derived from that. The results are summarized in Table 1.

Table 1: Passphrase translations by ChatGPT 4o together with derived passwords.

Language	Original phrase	Phrase extension	Password
German	Der frühe Vogel fängt den Wurm	... aber erst die zweite Maus kriegt den Käse	DfVfdW, aed2MkdK
English	The early bird catches the worm	…but only the second mouse gets the cheese	Tebctw, botsmgtc
Russian	Ранняя пташка ловит червя	… но только вторая мышь получает сыр	Рплч,а2мпс
French	Le monde appartient à ceux qui se lèvent tôt	… mais seule la deuxième souris attrape le fromage	Lmaaqlslt, msl2mac
Spanish	Al que madruga, Dios le ayuda	… pero solo el segundo ratón obtiene el queso	Aqmdlh, psr1oq

As a first observation it can be noticed that the LLM had in general significantly improved since the first attempt. It was able to recognize the original German proverb and translate it to its equivalent in other languages if such an equivalent exists (as it does literally in English and by meaning in French and Spanish). In Russian, which lacks a proverb with a similar meaning, the phrase is translated literally. The same happens with the (unofficial) extension which has no correspondence in any other language.

It is certainly venial for the AI not to realize that the extension only makes sense when related to the original phrase. This, however, may be seen as an indication that the LLM indeed did not actually understand the explanation of password generation in the text but rather seems to have deduced the

procedure from detecting a correspondence between the phrase and the resulting password (which is still a remarkable cognitive accomplishment, although it adds or loses single characters in some cases, fails in the consideration of capital and minor letters and – at least in some of the translations – also fails in transferring a word that represents a numeral into its corresponding numeric character).

4 CONCLUSIONS

Coming back to the initial research questions about how and to which extent GenAI can support the production of hypermedia edutainment material, a considerable gain in production speed could be found, especially with image generation and text adaptations like translation or reformulation within a given time frame. We have found the support of Generative AI significantly helpful for content production for a modular hypermedia or crossmedia network on a common theme. Although all GenAI output still required some human refactoring, it was well-suited to speed up the process of content creation. Despite expectable limitations the translation of narrative text even when it includes complex descriptions of a process like the generation of a password from passphrases based on proverbs for example, even including extensions and modifications, the GenAI showed – though still limited – considerable and unexpected abilities.

Despite the fact that we found several interesting hints to current abilities and limitations of GenAI tools for supporting the production of hypermedia narratives in an edutainment framework, in particular through image generation and the modification and translation of text, this study only casts a narrow spotlight on the subject, as it lacks a large-scale structured analysis. We intend to address this issue by our future work, which aims at gaining deeper insight into the varying requirements of our target groups and the parameters that influence learning success, as well as the progression of GenAI capabilities and in particular a structured analysis of how different LLM systems deal with the procedural description of complex tasks when provided in a narrative context.

ACKNOWLEDGEMENTS

The authors like to thank Karl N. Kirschner for thoroughly proofreading the English crime story translation. The Evangelische Erwachsenenbildung an Sieg und Rhein helped with conducting the interview study. This work is supported by the German Federal Ministry of Education and Research (BMBF) under the research grant 16KIS 1623.

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