

# My Own Electric Guitar with an On-Board Effect

Personal Project Report

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## Goal

My goal in my personal project has been clear to me from the beginning. I chose to make a guitar, because guitars and guitar playing is my hobby and passion, although I have never before made a guitar. I love playing the guitar and also the music played on it. I would consider myself a beginner to intermediate guitar player. From the physics point of view, I am very interested in the way our world works and which physical laws govern it. I think this interest in both, guitars and music and electronics and physics propelled me towards completing my final product. I set-out to make my own electric guitar and install an on-board distortion effect inside. This has driven me from the beginning to make the guitar as good as possible, tone-wise and usability-wise, because naturally, I would want to use it for playing after the project. Because I wanted to play the guitar after the project, I wanted a shape that suited me. Due to this, I tested out a few different shapes, including stratocasters, telecasters, Les Pauls, explorers, v-shapes, such as king v, flying v, vulture and other modified models of these shapes, and I came to the conclusion, that the shapes I wanted were the Ken Lawrence Explorer (see appendix: Fig. 1) or a Flying V (see appendix: Fig. 2), although I preferred the Explorer. Here is a picture of me testing out the explorer guitar shape in a local guitar store (see appendix: Fig. 3).

The next decision for me was to decide the guitar effect I would place inside the guitar. In this report, effect and pedal both refer to an electric guitar signal modulation effect. Joe Gore states that, “It may sound fun to have an onboard delay effect, but delays and most modulation effects can drain a battery in a few hours. Weigh the prospect of having to change the battery after every show, especially if the change involves disassembling your guitar. Not to mention the ecological toll of burning through all those batteries” (2). This fact narrowed the choice of the effect for me. Since I mostly listen to heavier music, namely hard rock, heavy metal and their respective subgenres, I play this same type of music. To play heavier music, you need a fatter, more distorted sound, so an overdrive pedal wouldn’t do the job. That is why I chose a distortion effect pedal, since they come with more distorted outputs than most overdrive pedals. I was looking at a wide variety of distortion pedals, but I was mostly inclining towards the Ibanez TS Mini (see appendix: Fig. 4), because of its size, quality and true bypass feature. According to Joe Gore, any guitar player who views guitar effects as an extension of their guitar thought at least once about putting the usual external effect inside of the guitar for easier control of the effects (1). Effects modulate the output coming from the guitar, so an effect is usually connected between the guitar and the amplifier. I wanted to try a different take on electric guitar sound modulation, so I decided to embed the effect into the guitar, instead of connecting it on the outside, which is the usual.

When defining my goal, I was heavily instructed to focus on a goal that would fit one of the six global contexts. And focus on one I did, I focused on Scientific and technical innovation (“MYP Global Contexts”). I think that I chose this global context, because I tend to lean to technical innovation over creativity. With this project I explored the natural laws of physics in creating a system of electronics that will produce an outcome in human societies, more precisely musical

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societies. I used my previous and gained knowledge in physics to help me complete this project. For me it is a lot easier to grasp a technical concept and improve it and modify it, instead of creatively inventing a new design. Also, my global context helped me make my goal more detailed. I could firmly decide on how to set my goal, what my expectations should be, and what my top priority for my personal project should be.

## Specifications & Criteria of the Product

The specifics and criteria for this guitar are as follows. The shape would be an explorer, ideally a specific type of explorer, the Ken Lawrence Explorer (see appendix: Fig. 1). The body would be made from either mahogany, basswood or swamp ash. The neck would be maple and the fretboard rosewood or maple. There would be 24 frets on the guitar. The pickups would be active pickups, ideally from EMG (see appendix: Fig. 5). The bridge would be a hard tail tune-o-matic bridge (see appendix: Fig. 6). In addition to the effect inside the guitar, the guitar would also have LED side markers (see appendix: Fig. 7) on the fretboard, for better playing in dark places, such as shows and performances. I set these criteria for myself before I even began working on the project, these criteria were on my mini-fair poster (see appendix: Fig. 17). I developed these criteria due to a number of reasons. The shape of the body was because of my personal preference, the material (body, neck, fretboard) depends on the price and also on the malleability of the material. The number of frets would depend on the availability, as the fretboard is too precise of a job, and I am not confident enough to attempt to make it by myself. I decided for the EMG pickups, as they are most commonly used in metal and that is what I will mostly play on the guitar. The hard tail bridge is because of the stability and easy tuning of the guitar. And the side markers for greater comfort and easier playing.

## Planning

After I set my goal and global context, and specified it, I began to form a plan for my personal project. What seemed like an easy task at the beginning turned out to be more difficult than it seemed. My first plan was to create an actual monthly plan for myself. This was advised to me by my supervisor. I also planned for myself to research different sources regarding prices, time issues and different options in the near future (see appendix: Fig. 8). From the beginning of the project I had two major plans. My first plan (A) was to contact a professional guitar craftsman and see, if I could somehow arrange an apprenticeship in his studio for me to create my guitar. I gathered the contact for one craftsman near me from my father and I contacted the craftsman (see appendix: Fig. 9). I tried to explain that I was working on my personal project, and tried to be as nice and kind as possible. However, Mr. Grebeň has not replied to this day. My second plan (B), which was my backup plan, was to purchase a guitar DIY kit, and assemble the guitar, and make the electronics myself, and since my global context is Scientific and technical innovation (“MYP Global Contexts”), I would still fulfil this context by incorporating the effect into the guitar (see appendix: Fig. 10).

After I decided for the second plan (B), since my first plan had no way to succeed, because I was lacking time, a studio, and the craftsman I contacted did not reply. I planned out what kit I would use, when I should buy it and when I should begin assembly. I decided on a different shape of a guitar than the explorer, since I had to plan ahead and think of the electronics cavity and if I could add an extra effect there. I had a meeting with a professional electrician and Mr. Ing. Ivan Demovič helped me a lot (Incorporating a Guitar Effect into an Electric Guitar Circuit). I got to Mr. Demovič through my mother. Although we met only once, we managed to cover everything I needed as I was prepared for the interview and I also found out I had expanded my knowledge in the area of physics – electronics, because I could perfectly understand Mr. Demovič, and we could talk fluently about scientific and technical terms surrounding the topic. Not only did he explain to me the crucial parts of some circuit blueprints that I did not understand, but he also helped me find a solution for the lever to activate my effect, which I later modified (see appendix: Fig. 11).

I then had to plan out my next process in the work, namely the research of electrical circuits in musical instruments and later modulation of an electric guitar signal (see appendix: Fig. 12). After gaining all the supplies, being done with all the research, I had to put the guitar together. For this, I also created a plan of action (see appendix: Fig. 13), which I followed thoroughly up until my final fair and until finishing my final product.

## Research

After I planned out my process, I began to research and gather data. During the mini fair, I was advised to research a lot, as my project was really difficult and needed extensive data to complete. I think that this feedback from other students, mostly last year's MYP 5 students, really helped me. Had it not been for the feedback, I probably would have overestimated the project completely.

With that being said, I researched my topic really thoroughly. The first area of my personal project I researched, was naturally the part, that I planned to do first, which was "How to build a guitar". Throughout this research process, I went through various different sources, including instructional articles on Instructables.com such as ("Build Your Own Electric Guitar!"). A video I used as an inspiration and also to help me with the general process (Project Electric Guitar). I used this source for inspiring myself, but mainly for gathering the tools for the creation of my guitar, summed up in a pricing plan I wrote for myself for better decision making and comparison of my two plans/options. After my change of plans, which I will talk about in the chapter Process, I had to research the electrical aspect of electric guitars and the creation process. I also researched the electrical aspects of guitar modulation effects. For this part of my research, I used sources like PremierGuitar (Joe Gore) to Basic Electric Guitar Circuits 1: Pickups (*Amplified Parts*). All of these sources were somehow related to guitars of course, but they were mainly credible posts from experienced guitar players.

For my last part of the project, soldering, I used a book source (*Spájkovanie*), in my native language. In that source I learned about the basics of soldering, what to do, what not to do when soldering, what to watch out for and how to perform the job, since I have never ever done it before. According to Kolečák and Prach, the mistakes in soldering with soft metals you have to watch out for, are cold surfaces, overheated surfaces, surfaces not covered by solder, solder not filling the connection, pores, holes, cracks and tears (155, 156). With this knowledge I was ready to begin the last part of my personal project, the process.

## Process

My process of creating my guitar began with the ordering of guitar parts. I chose this plan (B) because I had contacted Mr. Grebeň, but he didn't answer, and I considered my time, equipment, and the cost of materials vs the cost of the DIY kit (see appendix: Fig. 18). I ordered my parts from amazon.com. I had two guitars to choose from, as I noticed and liked these two in particular. Both of them were the guitar shapes that I previously mentioned, an Explorer (see appendix: Fig. 14) and a Flying V (see appendix: Fig. 15). My choice was quite difficult, as I had to think about a number of important factors in choosing the right model. The first factor I immediately thought about is the price. The price was however very similar for both models, so that was not much of a concern. The next factor I considered was obviously if I liked the finish and design of the parts, and how the guitar would look when assembled. Probably the last major factor was how much space there was in the electronics cavity, as I had to place a battery and a circuit-board with components inside. From the two choices I had, I decided for the Flying V, because, obviously, the cavity for the electronics is larger and the guitar is more appealing to me, color-wise. Then I ordered the DIY guitar kit.

After I received the kit, I almost immediately assembled the guitar. Of course, I only put together the parts, that required nothing to do with the electronics. This is how the guitar looked after assembly (see appendix: Fig. 16).

After I was finished with the research for my electronics, I began to gather my supplies. I shopped for electronics in a local electronics store, GM Electronic, where I could easily buy anything I needed. However, I missed one quite important electronic component, and it wasn't available in the store. This was a push/pull potentiometer, to switch the overdrive pedal on and off. As I could not get this part, I had to create an alternative for switching the overdrive on and off. After thinking about a solution for about a day, it suddenly struck me. I could use a lever switch and make the gain fixed with a resistor. So, I bought the necessary parts, and I went with the idea. During the day I tried to imagine the guitar circuit, I replaced parts, I tried to substitute parts, of course, all of this inside my head.

After I had my parts, I assembled the effect (see appendix: Fig. 17). I used a universal board for the effect. This assembly was quite interesting, but I succeeded at it. I did not encounter any technical difficulties with the assembly. After I assembled the pedal, I needed to connect the wiring inside the guitar, meaning the pickups, potentiometers and the output jack. I first wanted to achieve this by pressing the wires together with pliers and sticking them together with duct tape, but I found out that that doesn't work. So, I needed to solder the wires. Thankfully, our school had a soldering iron and also solder flux. The soldering was the most entertaining part of my project for me. Since I had no previous experience with soldering, I needed some help. My girlfriend, who has worked with electronics and soldered before was so kind to help me, and together we pieced the wiring together. I thought the guitar was done, but then I encountered a problem. One of the soldered wires had torn off, and needed re-soldering. So, the next morning, I re-soldered everything together, and



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afterwards strung my guitar. To this day, I can remember my gratefulness and excitement when I plugged the guitar in and it worked. But, another problem occurred, this time a little more complicated problem than re-soldering a wire. The effect pedal wasn't working. I knew there could be a number of reasons for this. Either the circuit wasn't right, or one of the wires was disconnected, or the battery was drained. I immediately searched for possible solutions. My first solution was replacing the battery. I assumed the battery was the culprit, because I had not checked if the battery was charged before I put it inside the guitar. So, I replaced the battery. But the problem persisted, and I did not have enough time to fix the problem, so I left it at that. After that, I tuned the guitar, and it is still usable, but without the effect.

## Evaluation

My personal project was a really interesting experience for me. I developed new skills and gained deep knowledge while diving into the world of guitar making.

My guitar was in my opinion pretty well crafted, although I did not do the whole job myself. If I were to compare the final product to my starting criteria, we can see a large difference. For starters, the shape of the guitar is a lot different from the plan. I planned to create an Explorer, but I actually bought a Flying V, because of my consideration of time and the size of the electronics cavity. You could say, that I failed my time management, because I needed to simplify the project for myself in order to complete it on time. The body is basswood, so that criterion is accomplished, also the neck and fretboard. The bridge is also a Gibson-style tune-o-matic, so I consider it correct. The number of frets on the final product is 22, but this is due to the fact that I chose a DIY kit, so I could not influence it in any way. The pickups are not the pickups I desired. This is mostly because of the price of these pickups, and also because there were pickups within the kit and I felt no need to buy other pickups.

The biggest outsider from my criteria has to be the not-working overdrive pedal. This pedal does not do its intended job, and because of that, I think I did not complete my task. The pedal is failing due to the reason that I did not buy and solder the pedal onto a breadboard, but I used a universal board. If I did this differently, I think I would have had a working guitar with a distortion pedal.

In my opinion, this project helped me develop my skills in physics, electronics and working with stringed musical instruments. I also bolstered my research skills, planning and a bit of time management. I understand the creation of the electronics in an electric guitar and the way electric guitars work very thoroughly, and I am able to explain it to anyone. The global context, Scientific and technical innovation is aiming to make students understand the workings of natural laws, which in my case was physics, and how the world around us is affected by them (“MYP Global Contexts”). It is an inquiry into the natural world and its laws and the interaction between the natural world and human societies. As I progressed on in my project, I had to inquire about physics and electronics, I had to be able to find critical solutions in many of my problems. I also had to know what to do and when and what not to do. In electronics, every circuit you make has to be perfect, otherwise it just won’t work. There is no element of luck there, there is just raw skill. I also wanted to make something very comfortable and easy to use for every guitar player that touched my guitar.

I think I was a thinker, inquirer, definitely a risk-taker, knowledgeable and open-minded. Thinker because I needed to critically assess my problems and find solutions for them. Inquirer because I was curious in my research for the natural electrical laws. A risk-taker because I took great risks with making the guitar, the price was quite high, and with electronics, everything needs to be perfect, otherwise it doesn’t work. Knowledgeable because I had to understand and develop the

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knowledge required to create a guitar. I also had to be open-minded to other ideas and plans because I knew I would probably have to change my expectations, and modify my plans.

## Conclusion

My personal project has been like a rollercoaster ride for me. I had good moments, bad moments, but my end result was satisfaction and joy. I had created a playable electric guitar. I am very happy with what it turned out to be, and although the distortion doesn't work, I will still play on it, and enjoy it (see appendix: Fig. 19). This process has been very educational for me, but I think I managed to enjoy it as well. My choice of topic was in my opinion very good, because I chose a challenge for me. If I would have succeeded in making the effect function as well, I would be really surprised, because I did not expect that everything would work, although I wanted it to. I have enjoyed this process and the things that came with it, and I think it was a beautiful way to finish my MYP journey.

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## Appendix

*Figure 1* Ken Lawrence Explorer guitar shape, typical for its headstock, taken from Ken Lawrence Explorer. Digital image. *Rig-Talk*. <https://www.rig-talk.com/forum/download/file.php?id=46372&mode=view>



*Figure 2* Flying V guitar shape, notice the aggressive design of the guitar, which was essential to the birth of heavy metal, taken from Flying V. Digital image. *Pin IMG*. <https://i.pinimg.com/originals/9b/f4/2a/9bf42afc0c2946b36bfc08141b42b6d0.jpg>.



*Figure 3* Me testing out a Dean Explorer, same explorer body, different headstock.



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*Figure 4* The Ibanez TS Mini, the small, battery powered version of the famous distortion pedal, taken from Ibanez Mini Tube Screamer. Digital image. *Musician's Friend*. <https://media.musiciansfriend.com/is/image/MMGS7/Tube-Screamer-Mini-Guitar-Effect-Pedal/J18495000000000-00-500x500.jpg>.



*Figure 5* Active pickups from EMG, they use a battery, taken from Active EMG Pickup. Digital image. *EMG Pickups*. <http://www.emgpickups.com/media/feature/feature/emg-81x.jpg>.



*Figure 6* The tune-o-matic hard tail bridge, the most widely used bridge, mostly for rhythm guitar players, taken from Tune-O-Matic Bridge. Digital image. *Thomann*. <https://www.thomann.de/blog/wp-content/uploads/2016/09/tune-o-matic-the-lord-of-guitar-bridges-8.jpg>.

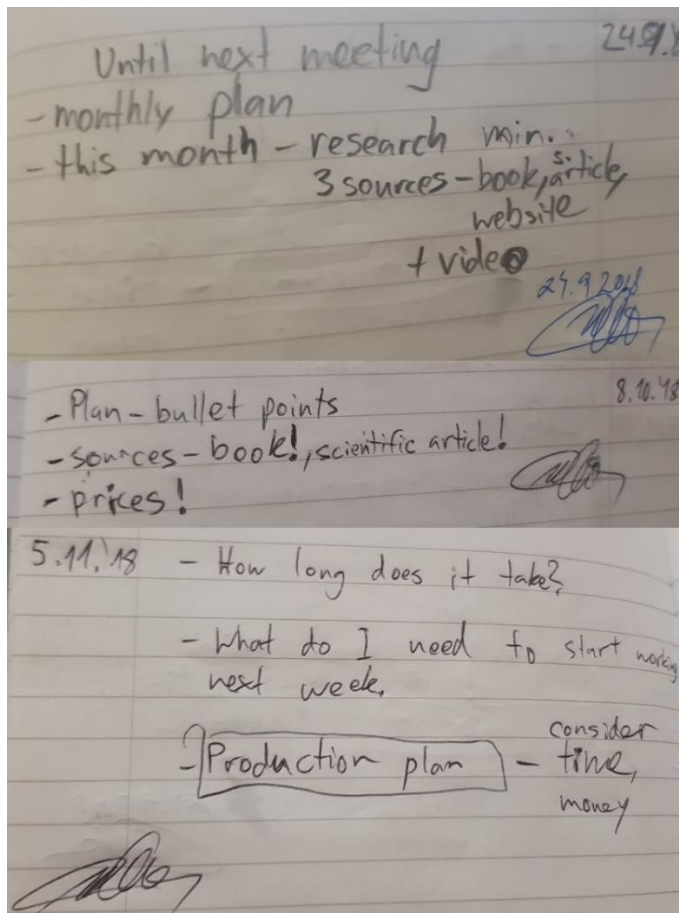


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**Figure 7** LED side position markers on the fretboard. Used mostly for stand-up guitar playing in darker places, taken from LED Markers. Digital image. *The Fiber Optic Store*. <https://thefiberopticstore.com/wp-content/uploads/2014/12/Midnight-lights.jpg>.



**Figure 8** A few excerpts from my process journal, which are showing the brief, but structural planning I performed.





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**Figure 9** My mail to Mr. Grebeň, a professional guitar craftsman, taken from mail.google.com.

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**Matúš Kollar** <kollarm9@gmail.com>  
komu: vyrobca ▾

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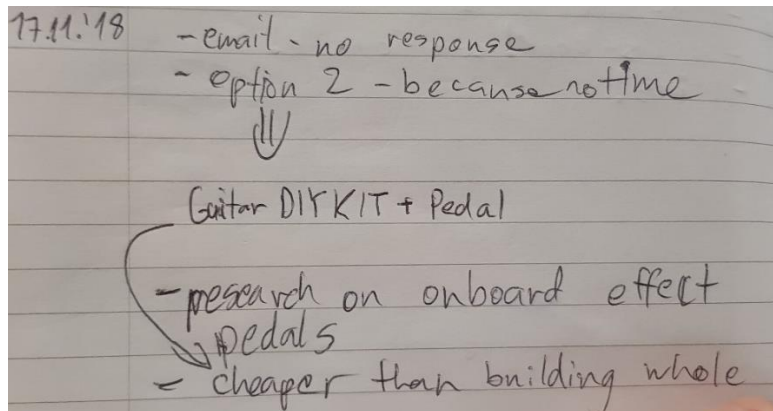
Dobrý deň pán Grebeň,  
volám sa Matúš Kollár a som študent na medzinárodnom programe na Gymnáziu Jura Hronca v Bratislave.  
Moja trieda (IBMP5) má tento rok v rámci medzinárodného programu osobný projekt (Personal Project). Je to projekt, pri ktorom každý študent za 3 mesiace vytvorí produkt, ktorý si sám zadal vopred a následne napíše o výrobe produktu prácu (Final Report).  
Píšem Vám pre to, lebo by som Vás chcel požiadať o pomoc pri tomto projekte, keďže je pre mňa dosť náročný. Mój produkt je elektrická gitara s vbudovaným pedálom. Termín na odovzdanie produktu je 8. februára.

Ďakujem vopred a prajem pekný víkend,  
Matúš Kollár

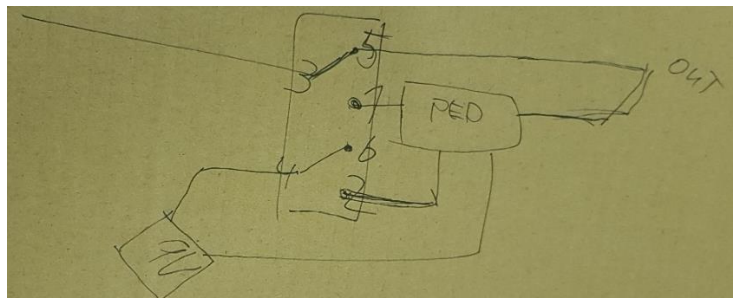
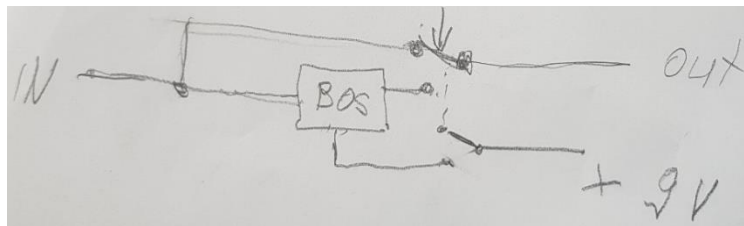
↶ Odpovedať

➡ Preposlať

**Figure 10** My plans after I received no response to my mail for 2 weeks.



**Figure 11** The plan for implementing the switch for the effect, drawn for me by Mr. Demovič, and my modification under it.



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Figure 12 Excerpts from my process journal showing my planning of research.

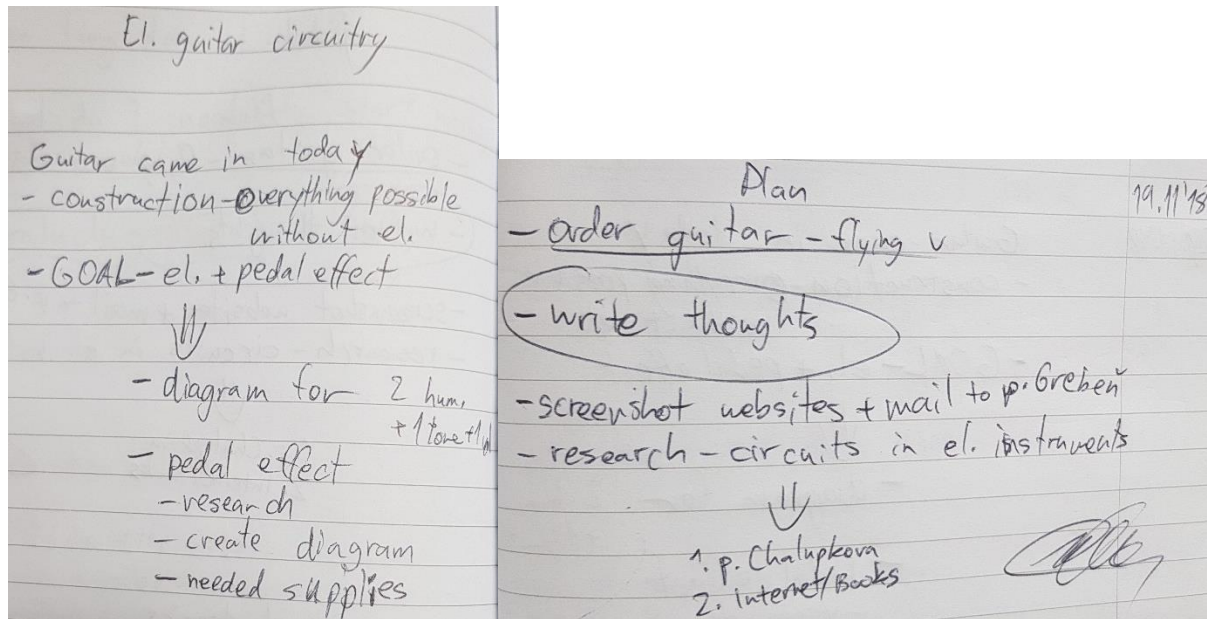
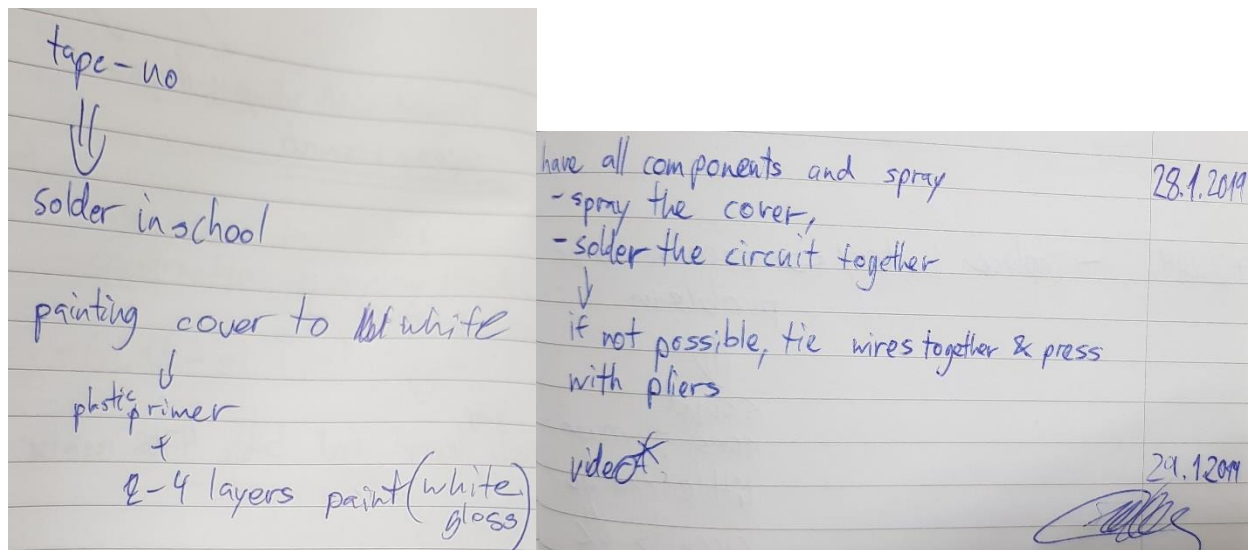
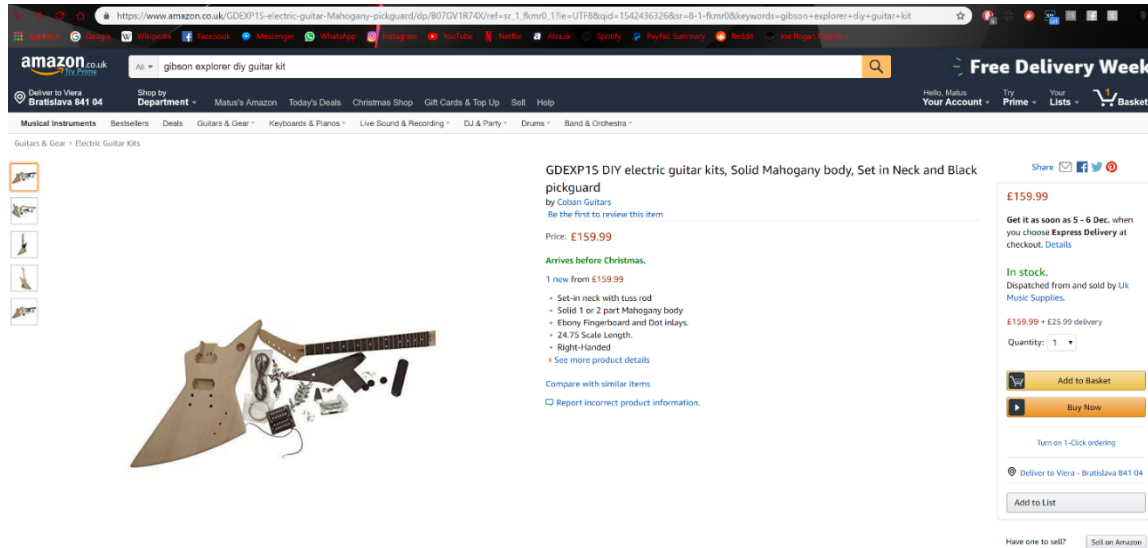


Figure 13 Process journal excerpts that show my simple plans of action.

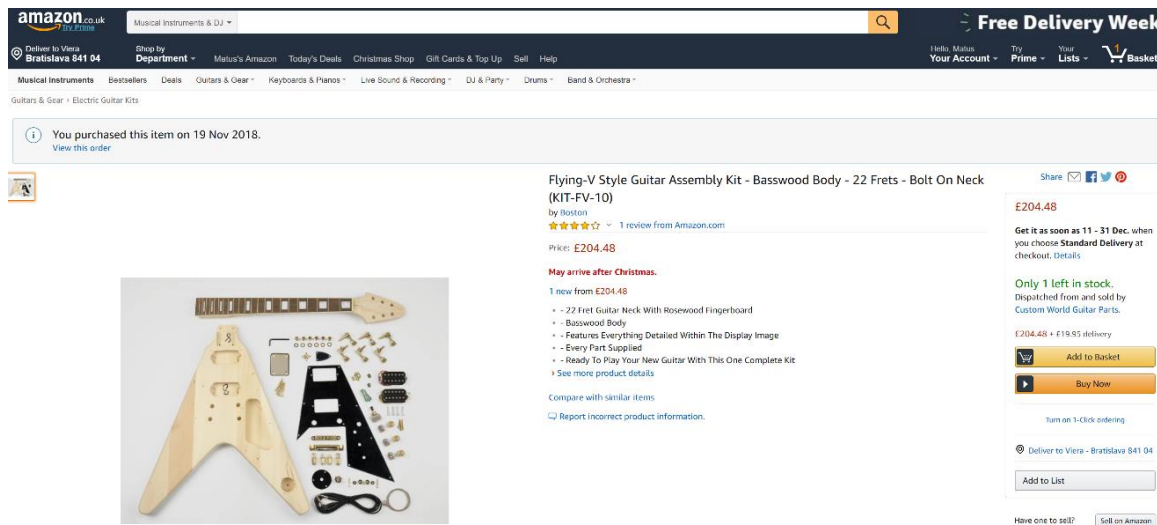


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**Figure 14** Explorer DIY Guitar Kit on amazon.com, taken from “GDEXP15 DIY Electric Guitar Kit.” *Amazon.co.uk*, [www.amazon.co.uk/GDEXP15-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr\\_1\\_fkmr0\\_1?ie=UTF8&qid=1542436326&sr=8-1-fkmr0&keywords=gibson%2Bexplorer%2Bdiy%2Bguitar%2Bkit](https://www.amazon.co.uk/GDEXP15-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr_1_fkmr0_1?ie=UTF8&qid=1542436326&sr=8-1-fkmr0&keywords=gibson%2Bexplorer%2Bdiy%2Bguitar%2Bkit).



**Figure 15** Flying V DIY Guitar Kit on amazon.com, taken from “Flying-V Style Guitar Assembly Kit - Basswood Body - 22 Frets - Bolt On Neck (KIT-FV-10).” *Amazon.co.uk*, [www.amazon.co.uk/Flying-V-Style-Guitar-Assembly-Kit/dp/B00JABZPG4/ref=pd\\_sbs\\_267\\_14?\\_encoding=UTF8&pd\\_rd\\_i=B00JABZPG4&pd\\_rd\\_r=850742b2-ea32-11e8-b7e3-a1b7f46d2172&pd\\_rd\\_w=i8kbx&pd\\_rd\\_wg=FQtrW&pf\\_rd\\_i=desktop-dp-sims&pf\\_rd\\_m=A3P5ROKL5A1OLE&pf\\_rd\\_p=18edf98b-139a-41ee-bb40-d725dd59d1d3&pf\\_rd\\_r=MMA7P9DNBEX36XG1SKJS&pf\\_rd\\_s=desktop-dp-sims&pf\\_rd\\_t=40701&psc=1&refRID=MMA7P9DNBEX36XG1SKJS](https://www.amazon.co.uk/Flying-V-Style-Guitar-Assembly-Kit/dp/B00JABZPG4/ref=pd_sbs_267_14?_encoding=UTF8&pd_rd_i=B00JABZPG4&pd_rd_r=850742b2-ea32-11e8-b7e3-a1b7f46d2172&pd_rd_w=i8kbx&pd_rd_wg=FQtrW&pf_rd_i=desktop-dp-sims&pf_rd_m=A3P5ROKL5A1OLE&pf_rd_p=18edf98b-139a-41ee-bb40-d725dd59d1d3&pf_rd_r=MMA7P9DNBEX36XG1SKJS&pf_rd_s=desktop-dp-sims&pf_rd_t=40701&psc=1&refRID=MMA7P9DNBEX36XG1SKJS).



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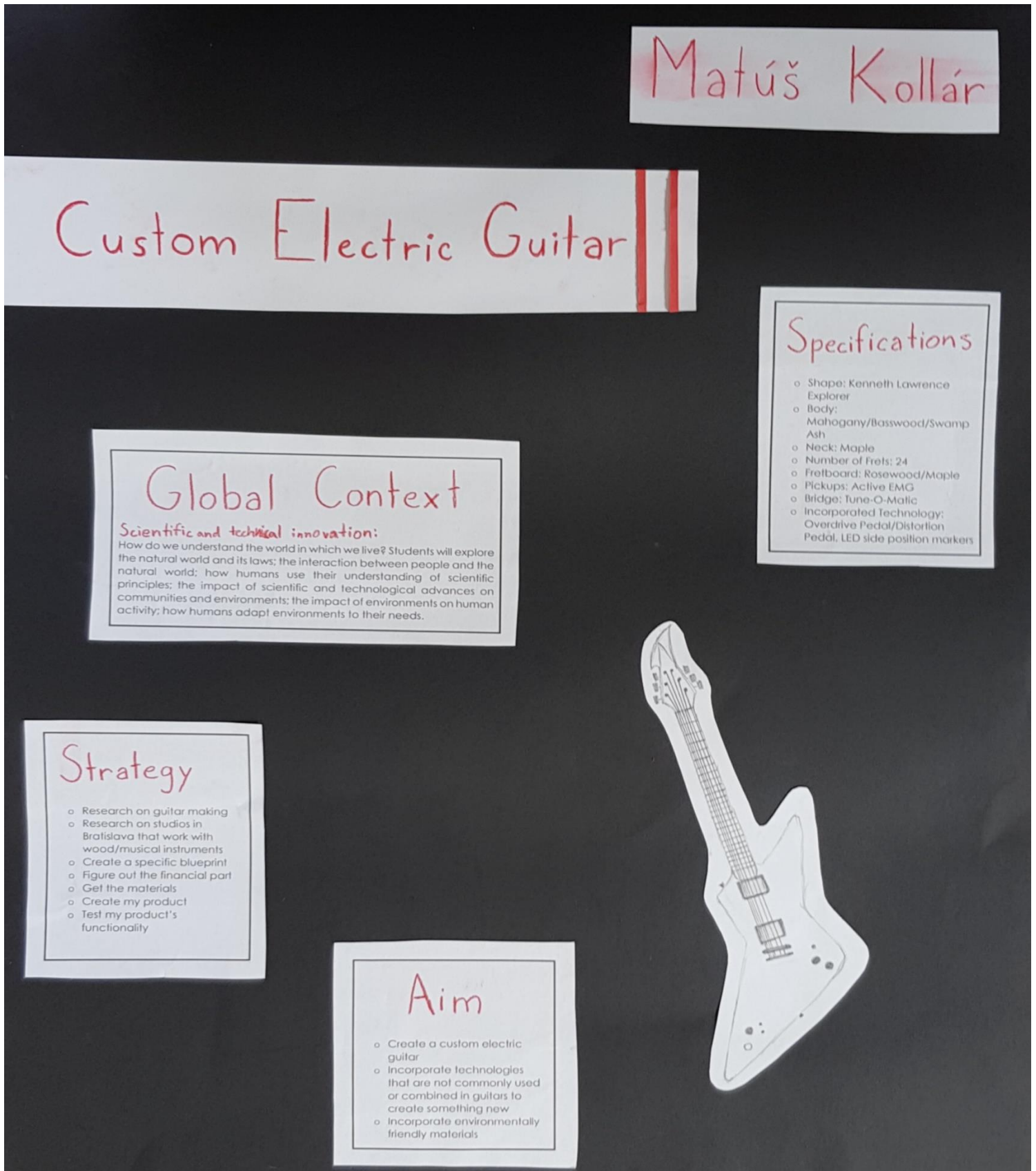
*Figure 16* My guitar after assembly without electronics.





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Figure 17 My final fair poster.



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*Figure 18*      The conclusion of my price research and comparison.

Plan A

Final Price Materials: £312.67(€357.63) + tonewood(body) + screws + plastic

Plan B

[https://www.amazon.co.uk/GDEXP1S-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr\\_1\\_6?ie=UTF8&qid=1541355434&sr=8-6&keywords=guitar+neck+explorer](https://www.amazon.co.uk/GDEXP1S-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr_1_6?ie=UTF8&qid=1541355434&sr=8-6&keywords=guitar+neck+explorer)

Guitar DIY

Explorer for 159.99\$ + shipping

[https://www.amazon.co.uk/GDEXP1S-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr\\_1\\_fkmr0\\_1?ie=UTF8&qid=1542436326&sr=8-1-fkmr0&keywords=gibson+explorer+diy+guitar+kit](https://www.amazon.co.uk/GDEXP1S-electric-guitar-Mahogany-pickguard/dp/B07GV1R74X/ref=sr_1_fkmr0_1?ie=UTF8&qid=1542436326&sr=8-1-fkmr0&keywords=gibson+explorer+diy+guitar+kit)

Flying V for 201.95\$ + shipping

[https://www.amazon.co.uk/Flying-V-Style-Guitar-Assembly-Kit/dp/B00JABZPG4/ref=pd\\_sbs\\_267\\_14?encoding=UTF8&pd\\_rd\\_i=B00JABZPG4&pd\\_rd\\_r=850742b2-ea32-11e8-b7e3-a1b7f46d2172&pd\\_rd\\_w=i8kx&pd\\_rd\\_wg=FQtrW&pf\\_rd\\_i=desktop-dp-sims&pf\\_rd\\_m=A3P5ROKL5A1OLE&pf\\_rd\\_p=18edf98b-139a-41ee-bb40-d725dd59d1d3&pf\\_rd\\_r=MMA7P9DNBEX36XG1SKJS&pf\\_rd\\_s=desktop-dp-sims&pf\\_rd\\_t=40701&psc=1&refRID=MMA7P9DNBEX36XG1SKJS](https://www.amazon.co.uk/Flying-V-Style-Guitar-Assembly-Kit/dp/B00JABZPG4/ref=pd_sbs_267_14?encoding=UTF8&pd_rd_i=B00JABZPG4&pd_rd_r=850742b2-ea32-11e8-b7e3-a1b7f46d2172&pd_rd_w=i8kx&pd_rd_wg=FQtrW&pf_rd_i=desktop-dp-sims&pf_rd_m=A3P5ROKL5A1OLE&pf_rd_p=18edf98b-139a-41ee-bb40-d725dd59d1d3&pf_rd_r=MMA7P9DNBEX36XG1SKJS&pf_rd_s=desktop-dp-sims&pf_rd_t=40701&psc=1&refRID=MMA7P9DNBEX36XG1SKJS)

Comparison

What else to buy:

Strings, pedal, Soldering Iron and Solder Flux and Wire, router?

<https://www.premierguitar.com/articles/21544-diy-how-to-install-onboard-effects?page=1>

<https://www.premierguitar.com/articles/21291-build-your-own-stompbox?page=3>

My Own Electric Guitar with an On-Board Effect  
Personal Project Report

*Figure 19* My final product – my guitar.

